NAVWEPS 16-30URM44-6

Handbook

Service Instructions

RADIO TEST SET AN/URM-44

TS-622

PUBLISHED BY DIRECTION OF
THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

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1 October 1962

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WARNING

This equipment employs high voltages (2000 volts) which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside the equipment unless the power cord is disconnected. Although bleeder circuits are used to prevent capacitors from retaining charges after power has been disconnected, avoid casualties by always discharging and grounding circuits before touching them.

INTRODUCTION

This publication covers service instructions for the Radio Test Set AN/URM-44 as manufactured by Specialty Electronics Development Corporation, Flushing, New York, under Contract numbers N383(24)-53352A (Serial nos. LK1-LK116) and N383(24)-66251A (Serial nos. AAF1-AAF121). Information and data concerning repairs, replacements, and adjustments that can be performed by organizational and field maintenance activities are included.

Refer to the Handbook of Operation Instructions (NAVWEPS 16-30URM44-5) for further information concerning the test set. The Illustrated Parts Breakdown (NAVWEPS 16-30URM44-8) contains the listings of serviceable parts and components. Instructions beyond the capabilities of field maintenance activities are included in the Handbook of Overhaul Instructions (NAVWEPS 16-30URM44-7).

Refer to MIL-STD-15 for electrical and electronic symbols used in this handbook and to MIL-STD-16 for electrical and electronic reference designations.

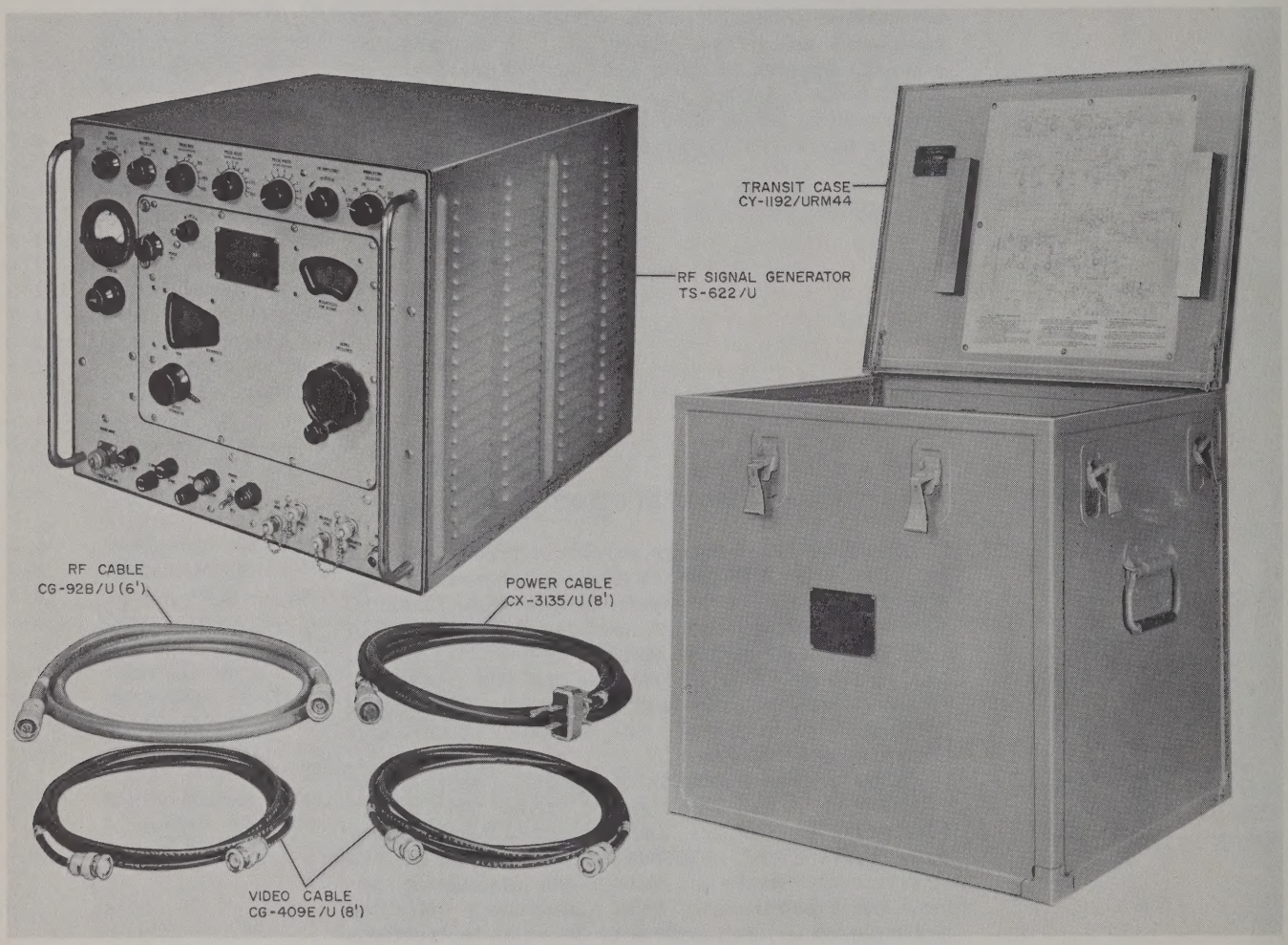


Figure 1-1. Radio Test Set AN/URM-44

SECTION I

DESCRIPTION AND LEADING PARTICULARS

1-1. GENERAL.

1-2. This publication comprises service instructions for the Radio Test Set AN/URM-44, manufactured by Specialty Electronics Development Corporation, Flushing, New York, under Contract numbers N383 (24)-53352A and N383(24)-66251A. Sections I through VII apply to this model and contract number. Additional models will be covered in Section VIII by the use of Difference Data Sheets.

1-3. PURPOSE OF EQUIPMENT.

1-4. Radio Test Set AN/URM-44 provides low-power radio-frequency test signals at frequencies from 7,000 to 10,750 megacycles per second, at power levels ranging from 10 to 127 db below one milliwatt (equivalent to a range from 70,000 microvolts to 0.1 microvolt when terminated in a 50-ohm load). The equipment provides continuous-wave, pulse-modulated, or frequency-modulated output test signals used to check operation of radio and radar equipments and to make laboratory measurements.

1-5. PHYSICAL DESCRIPTION. (See figures 1-1 and 1-2.)

1-6. Radio Test Set AN/URM-44 consists of Signal Generator TS-622/U, Transit Case CY-1192/URM-44, and accessory cables CX-3135/U(8'), CG-92B/U(6'), and CG-409E/U(8') (table I). Signal Generator TS-622/U is in its own metal instrument case that fits into the aluminum-and-plywood construction Transit Case CY-1192/URM-44, which has a compartment for storing the accessory cables and instruction handbooks. The chassis of the signal generator is held within its instrument case by four cam-lock captive fasteners, located at the rear of the case. Handles are provided on the front panel for carrying the generator and as a protection against damage to operating controls when the signal-generator chassis is removed from the instrument case for servicing.

1-7. Operating controls, receptacles, and protective and spare fuses are located at the front panel. They are identified as to function or value by etched characters on the gray enamel finish. Power monitoring meter, indicating dials, and indicator lamps are also located on the front panel.

1-8. The signal generator is not intended for use when removed from its instrument case. The metal case provides additional shielding to prevent spurious radiation and other leakage from the oscillator cavity on the chassis.

1-9. ELECTRICAL CHARACTERISTICS. (See figures 1-2 and 4-1.)

1-10. R-F SIGNAL GENERATOR. Signal Generator TS-622/U consists essentially of a velocity-modulated

TABLE I. EQUIPMENT SUPPLIED WITH RADIO TEST SET AN/URM-44

Quantity per Equipment	Description	Type	Overall Dimensions (Inches)			Volume (Cu.In.)	Weight (Lbs)
			Height	Width	Length		
1	RF Signal Generator	TS-622/U	14-3/4	17	19-1/8	4800	
1	Transit Case	CY-1192/URM-44	22	17-1/4	22-1/2	8550	
1	Power Cable	CX-3135/U(8')	-	-	96	-	
1	RF Cable	CG-92B/U(6')	-	-	72	-	
2	Video Cable	CG-409E/U(8')	-	-	96	-	
2	Handbook of Operation Instructions	NAVWEPS 16-30URM44-5	11	8-1/2	1/4	-	
2	Handbook of Service Instructions	NAVWEPS 16-30URM44-6	11	8-1/2	1/2	-	
2	Handbook of Overhaul Instructions	NAVWEPS 16-30URM44-7	11	8-1/2	3/8	-	
2	Illustrated Parts Breakdown	NAVWEPS 16-30URM44-8	11	8-1/2	1/2	-	

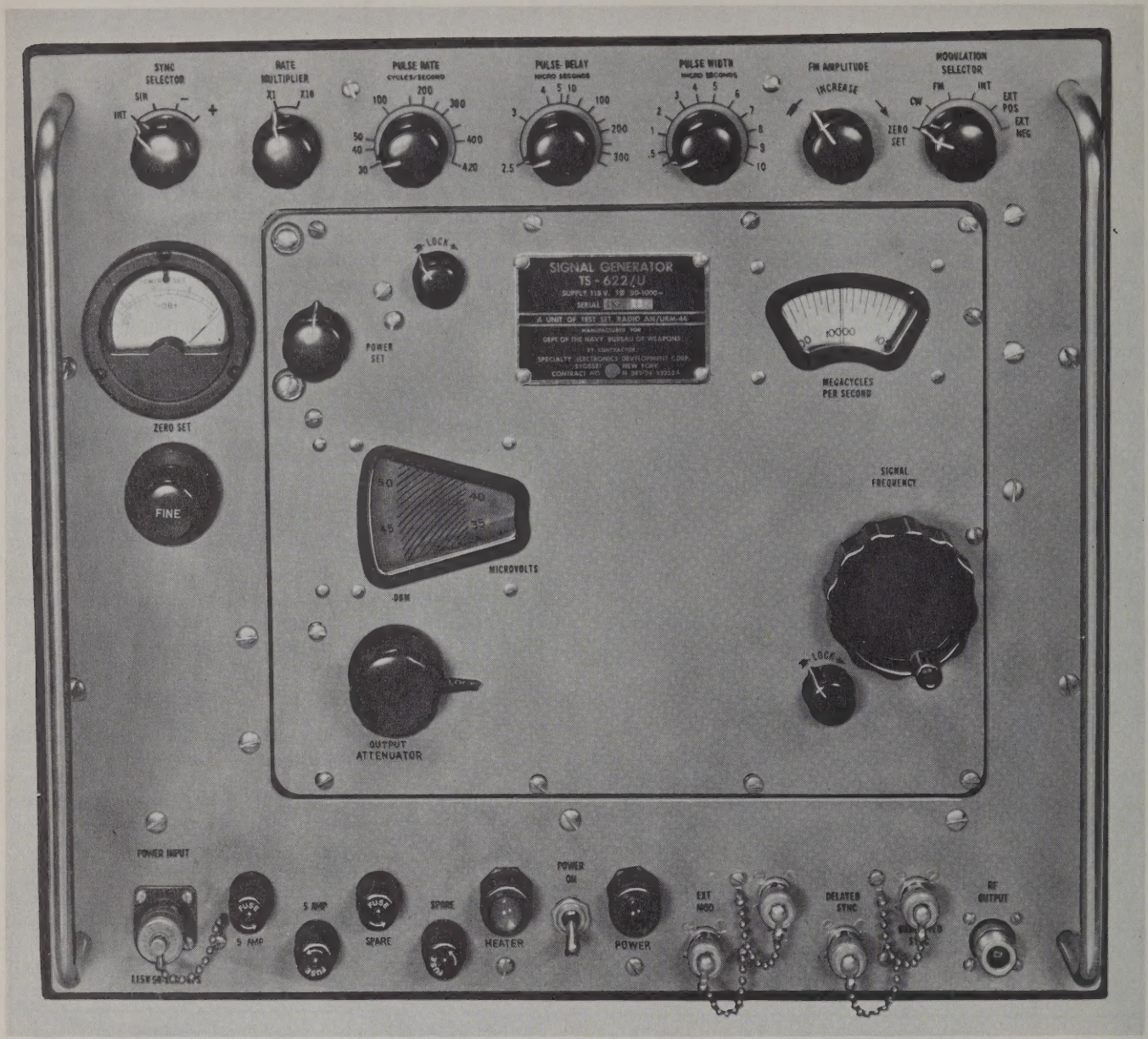


Figure 1-2. Signal Generator TS-622/U, Front Panel

reflex klystron tube within a cavity oscillator, a bolometer bridge for r-f output measurement, a direct-reading calibrated attenuator dial and control for varying the test-set power output, a direct-reading calibrated frequency dial and control for varying frequency output, associated r-f plumbing, and a modulator circuit. The modulator includes a sawtooth generator to produce the frequency-modulation output of the test set, and a pulse generator to produce the pulse-modulation output. Regulated d-c power supplies for the oscillator, modulator, and bolometer-bridge circuits are also included within the signal generator. The tube, fuse, and indicator-lamp complement is given in table II; a technical summary of the electrical characteristics is in table III.

1-11. EQUIPMENT SUPPLIED.

1-12. Refer to table I and to figure 1-1 for the list of equipment supplied with the test set. No other equipment is required for operation.

1-13. POWER REQUIREMENTS.

1-14. Signal Generator TS-622/U operates from a nominal 115-volt, 50 to 1000-cps, a-c power source, single-phase, with a 400-watt power consumption. The regulated power supplies in the signal generator enable the equipment to operate without change of calibration with line-voltage variations from 103.5 to 126.5 volts.

1-15. ELECTRON-TUBE, FUSE, AND INDICATOR-LAMP COMPLEMENT.

1-16. Table II lists tubes, fuses, and lamps used in the signal generator.

1-17. TECHNICAL SUMMARY.

1-18. Table III summarizes the technical specifications of the test set.

1-19. OPERATING AND ADJUSTMENT CONTROLS.

1-20. Table IV lists front-panel controls and connectors, their panel designations, illustration references, and functions.

1-21. Table V lists chassis adjustment controls, their chassis designations, illustration references, locations, and functions.

TABLE II. ELECTRON-TUBE, FUSE, AND INDICATOR-LAMP COMPLEMENT

	Type	Keyer and RF Box	Main Chassis	Modulator	Total per Equipment
Electron Tubes	12AT7WA	1	5	7	13
	6AK6	-	1	2	3
	6X4W	1	1	-	2
	6AU6WA	1	4	-	5
	OB2WA	-	2	-	2
	5R4WGA	-	4	-	4
	5651	-	5	-	5
	5933	-	1	-	1
	6080WA	1	1	-	1
	5721	1	-	-	1
	Total	4	24	9	37
Indicator Lamps	No. 47	2	2	-	4
	Total	2	2	-	4
Fuses	5 Amp	-	2 in use	-	4
		-	2 in spare	-	
	Total	-	4	-	4

TABLE III. TECHNICAL SUMMARY OF RADIO TEST SET AN/URM-44

Nomenclature	Radio Test Set AN/URM-44
Contract Numbers	N383(24)-53352A (Serial nos. LK1-LK116 and N383(24)-66251A (Serial nos. AAF1-AAF121)
Contractor	Specialty Electronics Development Corporation, Flushing, New York
Cognizant Naval Inspector	Inspector of Naval Material, USN New York, New York
Frequency Range	7,000 to 10,750 megacycles; continuous tuning in one band. Tuning dial calibrated at 50-megacycle intervals to within ± 1 percent of actual frequency.
Type of Emission	Cw, am (pulse-modulated), or fm.
Power Range	Continuously adjustable within range from 10 to 127 db below one milliwatt across a 52-ohm resistive load for c-w operation; within ± 1 decibel of this range for pulse operation.
Modulation Capability	Pulse modulation from self-contained pulse generator, or from an external modulation source. Frequency modulation from self-contained sawtooth generator.

TABLE III. TECHNICAL SUMMARY OF RADIO TEST SET AN/URM-44 (cont)

a. From self-contained pulse generator.	(1) Adjustable repetition rate from 40 to 4000 pulses per second.
	(2) Adjustable pulse width from 0.5 to 10 microseconds, measured between points on initial rise and decay which are 50 percent of largest amplitude of initial rise.
	(3) Pulse rise time less than 0.5 microseconds, as measured from 10 percent to 90 percent of full amplitude.
	(4) Pulse decay time less than 0.5 microseconds, as measured from 90 percent to 10 percent of full amplitude.
	(5) Delay between the leading edge of the undelayed trigger pulse (either internally generated or derived from externally applied sync signal) and leading edge of the pulse-modulated r-f test signal adjustable between 3 and 300 microseconds, but not greater than 75 percent of the pulse period. (See figure 4-2 for pulse delay time obtainable at any setting of pulse-rate controls.)
b. From external source supplying modulating signal.	(1) Required pulse amplitude between 15 and 70 volts, positive or negative polarity.
	(2) Required pulse width between 0.5 and 2500 microseconds.
	(3) Required pulse spacing between 1 and 2500 microseconds.
	(4) Required pulse rise and decay times between 0.1 and 1 microsecond, as measured between 10 percent and 90 percent of full amplitude.
c. From self-contained sawtooth (f-m) generator.	(1) Sweep rate adjustable from 40 to 4000 sweeps per second.
	(2) Deviation adjustable from zero to at least plus and minus 3 megacycles.
	(3) Maximum change in power output during a deviation up to 3 megacycles is less than 3 db.
External Sync Sources	Either sine-wave or pulse-type source.
a. Sine-wave sync.	(1) Required frequency between 40 and 4000 pulses per second.
	(2) Required amplitude between 5 and 50 volts rms.
b. Pulse-signal sync.	(1) Required repetition rate between 40 and 4000 pulses per second.
	(2) Required amplitude between 5 and 50 volts peak, positive or negative polarity.
	(3) Required pulse rise time between 0.1 and 1 microsecond.
	(4) Required pulse width between 0.5 and 5 microseconds.
Sync Output Signals Available From Test Set.	Both undelayed and delayed video output sync signal available. Delay is measured from leading edge of modulator trigger pulse (either internally generated or synchronized with an externally applied sync input signal) to leading edge of r-f test signal.
a. Undelayed sync output.	(1) Positive polarity, between 25 and 100 volts pulse amplitude.
	(2) Pulse width between 0.5 and 5 microseconds.

TABLE III. TECHNICAL SUMMARY OF RADIO TEST SET AN/URM44 (cont)

a. Undelayed sync output. (cont)	(3) Pulse rate between 40 and 4000 pulses per second, identical with rate of pulse-modulated r-f test signals. (4) Pulse rise and decay time less than 1 microsecond. (5) Required load 500 to 100,000 ohms resistance, shunted by maximum of 500 micromicrofarads capacitance.
b. Delayed sync output.	(1) Positive polarity, between 25 and 100 volts pulse amplitude. (2) Pulse width between 0.5 and 5 microseconds. (3) Pulse rate between 40 and 4000 pulses per second identical with rate of pulse-modulated r-f test signal. (4) Pulse rise and decay times less than 1 microsecond. (5) Required load 500 to 100,000 ohms resistance, shunted by maximum of 500 micromicrofarads capacitance. (6) Delayed sync output timed to occur within ± 1.0 microsecond of leading edge of pulse-modulated r-f test signal.
Output Impedance at RF OUTPUT Receptacle	52 ohms. Standing-wave ratio less than 6db looking backward in operative signal generator using external signal of 7,000 to 10,750 megacycles through a 52-ohm line.
Power Requirements	103.5 to 126.5-volt, 50 to 1000 cps, single-phase a-c.
Power Consumption	Approximately 400 watts at power factor of about 85 percent.

TABLE IV. OPERATING CONTROLS AND CONNECTORS

Panel Designation	Illustration	Function
POWER INPUT and POWER ON-OFF switch (J14 and S5)	Fig. 1-2	POWER INPUT receptacle connects test set to 115-volt, 50 to 1000-cps source via power cable CX-3135/U(8'). Operating power is applied to test-set space heaters and to HEATER indicating lamp with POWER switch in OFF position. POWER ON-OFF switch in ON position applies nominal 115-volt a-c power to power transformers, time-delay relay, and POWER ON indicating lamp. Space heaters are disconnected from power source in ON position of switch.
RF OUTPUT receptacle (J113)	Fig. 1-2	Connects r-f test signal (c-w, f-m, or pulse modulated, as desired) via r-f cable CG-92B/U(6') to equipment under test, when MODULATION SELECTOR is set to any position other than ZERO SET.
SIGNAL FREQUENCY control and dial	Fig. 1-2	Rotation of control drives reflex-klystron-oscillator tuning mechanism and dial to set signal-generator operating frequency. Dial is directly calibrated in frequency at 50-megacycle intervals.
MODULATION SELECTOR (S3)	Fig. 1-2	Switch is rotated to ZERO SET position to make the r-f oscillator circuit inoperative for initial calibration procedure. After zero-setting power level meter through adjustment of ZERO SET controls (as directed below), switch permits selection of c-w, f-m, or pulse-modulation output, as desired.

TABLE IV. OPERATING CONTROLS AND CONNECTORS (cont)

Panel Designation	Illustration	Function
		For pulse operation, switch permits selection of internal pulse generator, external positive modulating signal, or external negative modulating signal as source for r-f oscillator pulse modulation.
ZERO SET FINE and coarse controls (R209A and B)	Fig. 1-2	With MODULATION SELECTOR in ZERO SET position, these potentiometers permit calibration of internal power-monitor bridge circuit, as indicated by deflection of meter M1 pointer to ZERO SET position.
POWER SET control	Fig. 1-2	With MODULATION SELECTOR in CW position, this control permits adjustment of amount of r-f current flowing through power-monitor bridge. When meter pointer deflects to zero db mark (by adjustment of this control), power level of signals at RF OUTPUT jack can be read directly from calibrated OUTPUT ATTENUATOR dial. If meter pointer cannot be deflected to zero db mark by adjustment of this control, power-monitor meter indication must be added algebraically to calibrated OUTPUT ATTENUATOR dial indication.
OUTPUT ATTENUATOR control and dial (AT1)	Fig. 1-2	This control mechanically drives r-f output attenuator and dial to control test-set r-f output power. Dial is directly calibrated in decibels below one milliwatt across 52-ohm resistive load at front panel RF OUTPUT receptacle.
SYNC SELECTOR (S1)	Fig. 1-2	This four-position switch selects type of synchronizing signal (when used) applied to self-contained modulator circuit. a. In INT position, modulator develops pulse or sawtooth output (as determined by setting of MODULATION SELECTOR) without synchronization from external equipment. b. In SIN position, internal pulse or sawtooth generator is synchronized with sine-wave sync signal from external equipment, with the signal applied to the front panel SYNC IN jack (J4). c. In "-" position, internal pulse or sawtooth generator is synchronized with negative-polarity video pulses from external equipment, with the signal applied to front panel SYNC IN jack. d. In "+" position, internal pulse or sawtooth generator is synchronized with positive-polarity video pulses from external equipment, with signal applied to the front panel SYNC IN jack.
RATE MULTIPLIER switch (S2)	Fig. 1-2	This two-position switch selects range of pulse repetition rate (with MODULATION SELECTOR in INT position), and range of sweep rate (with MODULATION SELECTOR in FM position). In the X1 position of RATE MULTIPLIER switch, a range of 40 to 400 pulses or sawtooth sweeps per second is available; in X10 position, a range of 40 to 4000 pulses or sawtooth sweeps per second is available.
PULSE RATE control (R41A and B)	Fig. 1-2	This dual-potentiometer control selects pulse repetition rate of modulator, when MODULATION SELECTOR is in INT position. Control also selects sawtooth sweep rate when MODULATION SELECTOR is in FM position. Rate is read directly from the calibrated panel markings when RATE MULTIPLIER is in X1 position. Pulse rate is 10 times calibrated panel markings when RATE MULTIPLIER is in X10 position.

TABLE IV. OPERATING CONTROLS AND CONNECTORS (cont)

Panel Designation	Illustration	Function
FM AMPLITUDE control (R36)	Fig. 1-2	This control is operative only when MODULATION SELECTOR is in FM position. Control sets magnitude of sawtooth signal applied to the repeller of reflex-klystron oscillator. Range of frequency deviation available is from zero deviation (extreme counterclockwise setting) to at least plus or minus 3 megacycles.
PULSE DELAY control (R17)	Fig. 1-2	This control is operative when MODULATION SELECTOR is in INT (internal pulse modulation) or FM (frequency modulation) position. Control permits adjustment of delay between leading edge of undelayed sync pulse and leading edge of r-f output test signal over the range from 3 to 300 microseconds, but not greater than 75 percent of pulse period, as shown in figure 4-2.
PULSE WIDTH control (R65)	Fig. 1-2	This control is operative only when MODULATION SELECTOR is in INT (internal pulse modulation) position. Control permits adjustment, from 0.5 to 10 microseconds, of pulse width of r-f test signal. Width is measured between points on initial wise and decay that are 50 percent of peak amplitude of initial rise.
EXT MOD jack (J10)	Fig. 1-2	This jack is utilized only when MODULATION SELECTOR is in EXT POS or EXT NEG position. Jack connects test set, with video cable CG-409E/U(8'), to a source of external modulating voltage, of positive or negative polarity. Setting of the MODULATION SELECTOR must correspond with polarity of applied external modulating signal.
SYNC IN jack (J4)	Fig. 1-2	This jack is utilized when synchronizing signal generator TS-622/U with external equipment. MODULATION SELECTOR is in FM or INT position to produce frequency-modulated or pulse-modulated output, as desired. Jack connects test set, with video cable CG-409E/U(8'), to a sine-wave or pulse sync signal. SYNC SELECTOR must be rotated to panel designation that corresponds with type of sync signal applied.
DELAYED SYNC jack (J8)	Fig. 1-2	This jack is utilized (with MODULATION SELECTOR in FM or INT position) to trigger external equipment under test with positive video pulse output from signal generator. This pulse output, delayed from 3 to 300 microseconds (up to 75 percent of the pulse period) from the leading edge of undelayed synchronizing signal, is fed to external equipment with video cable CG-409E/U(8').
UNDELAYED SYNC jack (J6)	Fig. 1-2	This jack is utilized (with MODULATION SELECTOR in FM or INT position) to trigger external equipment under test with positive video pulse output from signal generator, undelayed with respect to leading edge of modulator trigger pulse. This output is fed to external equipment with video cable CG-409 E/U(8').

TABLE V. CHASSIS ADJUSTMENT CONTROLS

Chassis Designation	Illustration	Location and Function
METER SENSITIVITY R206	Fig. 6-8	Left side of chassis. Sets level of d-c current through meter M1. When meter pointer deflects to 0 DB calibration mark on scale, r-f power output available at RF OUTPUT jack J13 may be read directly from the calibrated OUTPUT ATTENUATOR dial.

TABLE V. CHASSIS ADJUSTMENT CONTROLS (cont)

Chassis Designation	Illustration	Location and Function
COARSE BALANCE R211	Fig. 6-8	Left side of chassis. Calibrates front panel ZERO SET controls R209A and R209B so that range of the front-panel controls always gives an on-scale meter pointer deflection.
-1250 V ADJ R155	Fig. 6-6	Right side of chassis. Sets regulated output of the beam power supply to minus 1250 volts with respect to chassis ground.
+250 V ADJ R192	Figs. 6-6, 6-8	Rear of chassis. Sets regulated output of 250-volt power supply to plus 250 volts with respect to chassis ground.
-1700 V ADJ R129	Fig. 6-6	Right side of chassis. Sets regulated output of repeller power supply to minus 1700 volts with respect to chassis ground.
-1100 V ADJ R115	Fig. 6-8	Left side of chassis. Sets regulated output of keyer supply to minus 1100 volts and minus 1358 volts with respect to chassis ground.
BEAM CURRENT ADJ R84	Fig. 5-2	Right side of keyer chassis. Sets grid potential of the reflex-klystron oscillator tube V13 for proper anode current.
TRACK 1 R96, TRACK 2 R92, TRACK 3 R93, TRACK 4 R94	Fig. 5-2	Right side of keyer chassis. Used in recalibration procedure to obtain proper power output of -10dbm or more throughout tuning range of signal generator. This power output is equivalent to a zero db pointer deflection on POWER SET meter M1 with MODULATION SELECTOR S3 at CW position.
REFLECTOR VOLTAGE TRIMMER R91	Fig. 5-2	Rear of keyer chassis. Used in recalibration procedure to set initial points, at high and low ends of tuning range, for proper power output of the reflex-klystron oscillator tube V13.
METER SELECTOR S6	Figs. 5-3, 6-11	Top of main chassis. This switch has two positions, designated BEAM CURRENT and POWER MONITOR. BEAM CURRENT position is used in recalibration procedure only. BEAM CURRENT ADJ R84 is rotated to obtain a pointer deflection on POWER SET meter to red-line calibration mark, with MODULATION SELECTOR S3 at CW position. POWER MONITOR position is normal position of S6 when the signal generator is used to produce r-f modulated or unmodulated signals. This position places POWER SET meter in the r-f power monitor bridge circuit, which provides indications of r-f signal level at RF OUTPUT jack J13.
40 PPS ADJ R48	Fig. 6-9	Bottom of modulator chassis. Used in recalibration procedure only for setting low pulse-repetition-frequency limit of rate multivibrator tube V6.
4000 PPS ADJ R49	Fig. 6-9	Bottom of modulator chassis. Used in recalibration procedure only for setting high pulse-repetition-frequency limit of rate multivibrator tube V6.

TABLE V. CHASSIS ADJUSTMENT CONTROLS (cont)

Chassis Designation	Illustration	Location and Function
ADJUST DELAY R25	Figs. 6-9, 6-10	Side of modulator chassis. Used in recalibration of the front-panel PULSE DELAY control only to set 300-microsecond limit of control.
ADJUST WIDTH R58	Figs. 6-9, 6-10	Side of modulator chassis. Used in recalibration of front-panel PULSE WIDTH control only in obtaining pulse durations from 0.5 to 10 microseconds with MODULATION SELECTOR S3 at INT position and SYNC SELECTOR S1 at any position.
ADJUST V4A BIAS R29	Fig. 6-9	Side of modulator chassis. Used in recalibration procedure only for initially adjusting operation of delayed sync blocking oscillator V4A.
ADJUST V4B BIAS R30	Fig. 6-9	Side of modulator chassis. Used in recalibration procedure only for initially adjusting operation of delayed trigger blocking oscillator V4B.

SECTION II

TEST EQUIPMENT AND SPECIAL TOOLS

2-1. TEST EQUIPMENT.

2-2. No special test equipment is required to service the Signal Generator TS-622/U. Standard test equipment required are listed in table VI.

2-3. SPECIAL TOOLS.

2-4. No special tools are required to service the Signal Generator TS-622/U. Four socket-head-screw wrenches and a spanner wrench are provided in the set for loosening set screws and for removing the knurled nut at the end of the oscillator tuned cavity.

2-5. CABLE FABRICATION.

2-6. Refer to figures 2-1 through 2-3 for materials and procedures required for fabrication of the Power Cable CX-3135/U(8'), R-F Cable CG-92B/U(6'), and Video Cable CG-409E/U(8') supplied with the test set.

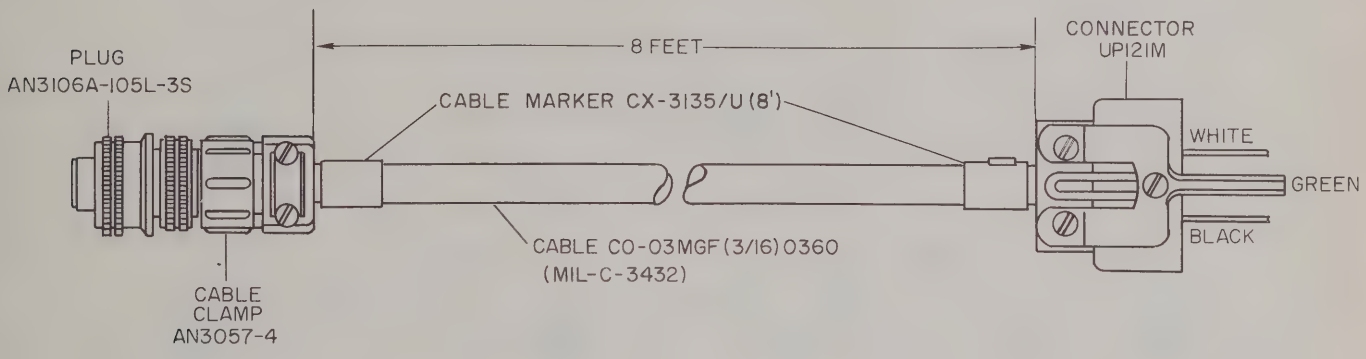


Figure 2-1. Power Cable CX-3135/U(8')

TABLE VI. TEST EQUIPMENT REQUIRED FOR MAINTENANCE

Name	AN Type or Mfr's Designation	Alternate	Use
Multimeter	AN/PSM-4	TS-352/U	General electronic testing
Oscilloscope	AN/USM-32	AN/USM-24	Waveform measurements
Electron Tube Test Set	AN/USM-31		Tube Testing
Frequency Meter	TS-186/UP		Recalibration
Audio Oscillator	TS-382A/U		Recalibration
Crystal Mount with d-c return	PRD Type 763		Recalibration
Crystal Diode 1N23B			Recalibration
Frequency Meter	Hewlett-Packard Model X530A		Recalibration
Frequency Meter	Hewlett-Packard Model J530A		Recalibration

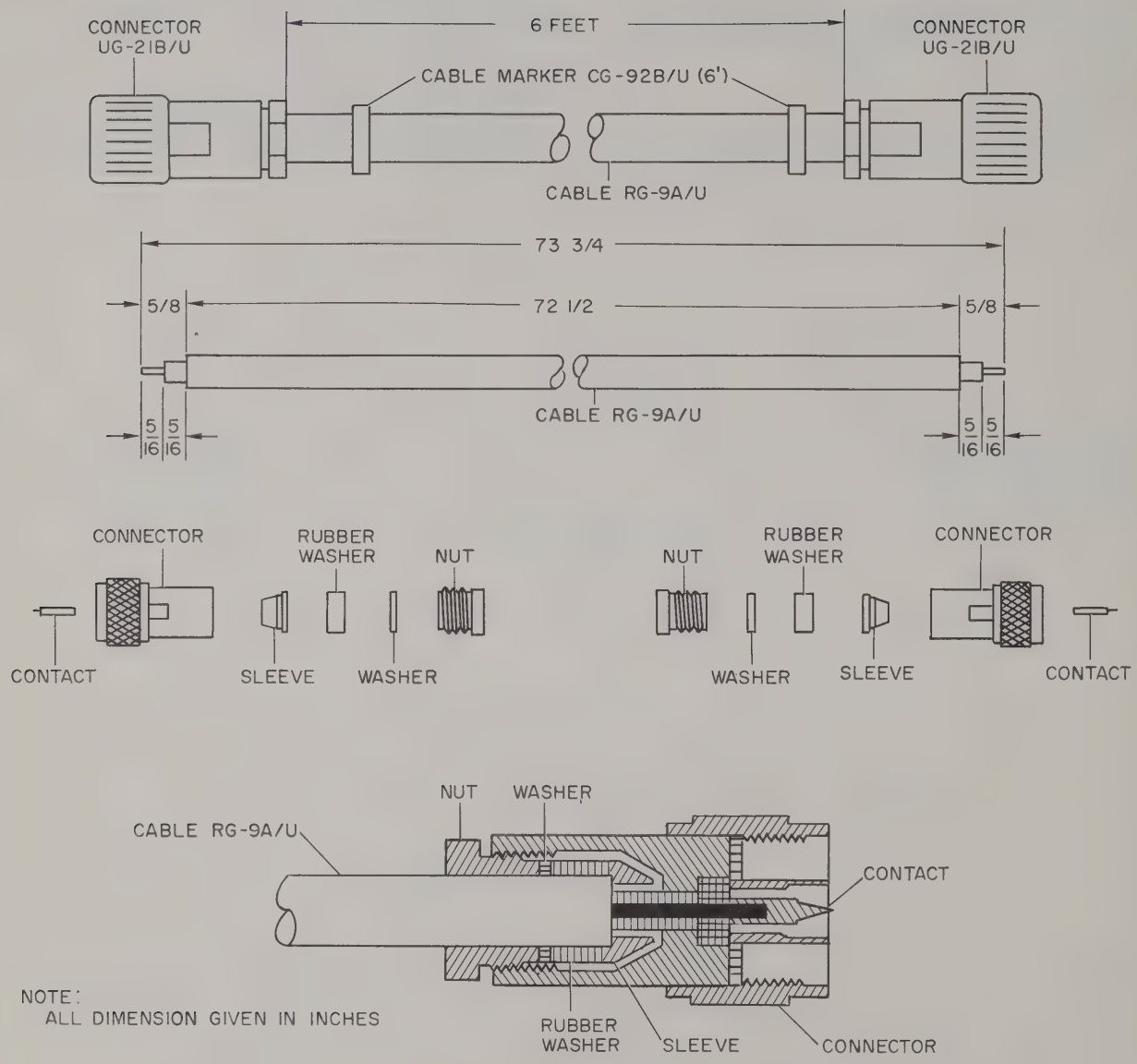


Figure 2-2. RF Cable CG-92B/U(6')

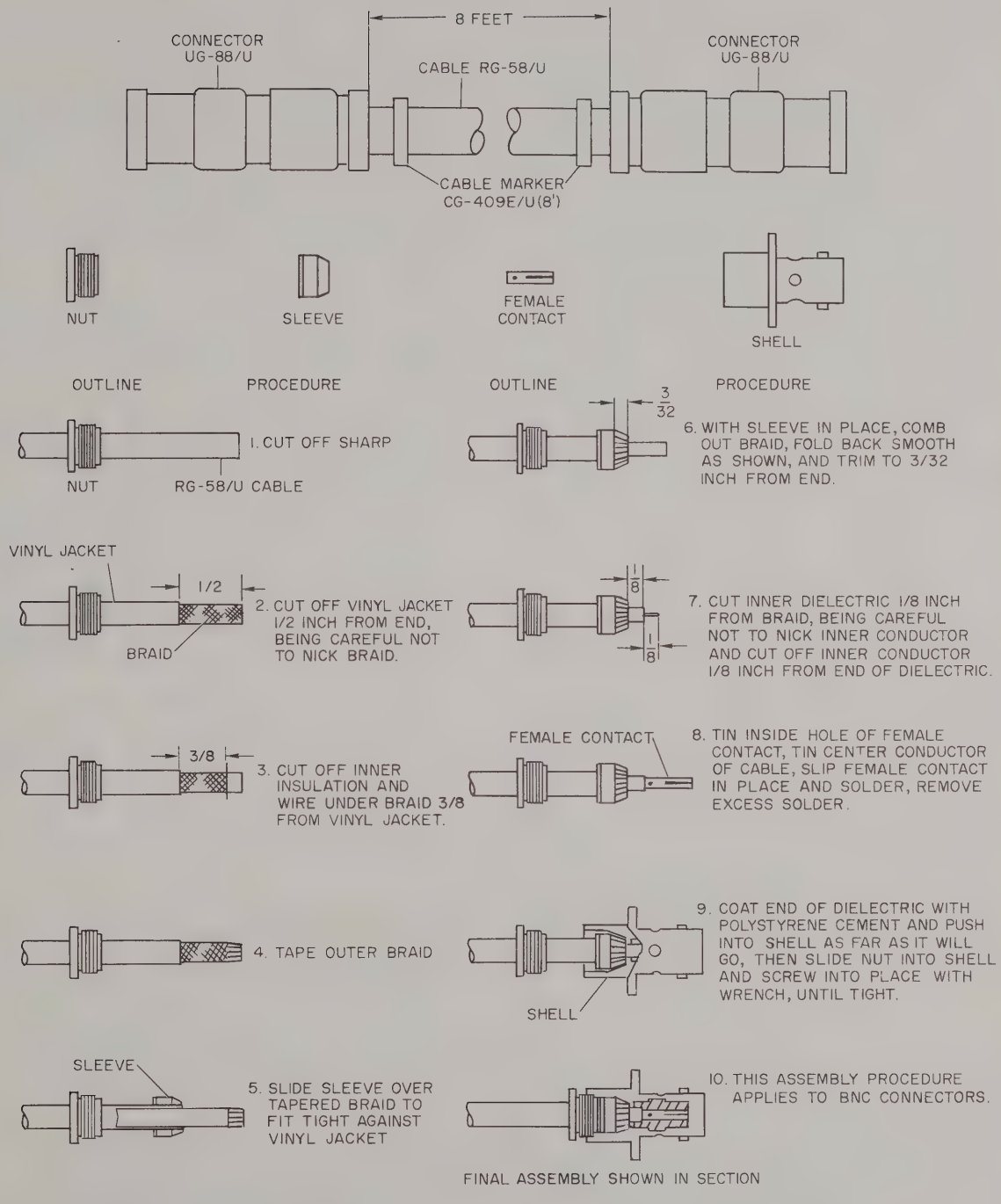

8 FEET
CONNECTOR UG-88/U
CABLE RG-58/U
CONNECTOR UG-88/U
CABLE MARKER CG-409E/U(8')
NUT
SLEEVE
FEMALE CONTACT
SHELL
OUTLINE
PROCEDURE
1. CUT OFF SHARP
NUT
RG-58/U CABLE
VINYL JACKET
1/2
BRAID
2. CUT OFF VINYL JACKET 1/2 INCH FROM END, BEING CAREFUL NOT TO NICK BRAID.
3/8
3. CUT OFF INNER INSULATION AND WIRE UNDER BRAID 3/8 FROM VINYL JACKET.
4. TAPE OUTER BRAID
SLEEVE
5. SLIDE SLEEVE OVER TAPERED BRAID TO FIT TIGHT AGAINST VINYL JACKET
OUTLINE
PROCEDURE
3/32
6. WITH SLEEVE IN PLACE, COMB OUT BRAID, FOLD BACK SMOOTH AS SHOWN, AND TRIM TO 3/32 INCH FROM END.
1/8
1/8
7. CUT INNER DIELECTRIC 1/8 INCH FROM BRAID, BEING CAREFUL NOT TO NICK INNER CONDUCTOR AND CUT OFF INNER CONDUCTOR 1/8 INCH FROM END OF DIELECTRIC.
FEMALE CONTACT
8. TIN INSIDE HOLE OF FEMALE CONTACT, TIN CENTER CONDUCTOR OF CABLE, SLIP FEMALE CONTACT IN PLACE AND SOLDER, REMOVE EXCESS SOLDER.
9. COAT END OF DIELECTRIC WITH POLYSTYRENE CEMENT AND PUSH INTO SHELL AS FAR AS IT WILL GO, THEN SLIDE NUT INTO SHELL AND SCREW INTO PLACE WITH WRENCH, UNTIL TIGHT.
SHELL
10. THIS ASSEMBLY PROCEDURE APPLIES TO BNC CONNECTORS.
FINAL ASSEMBLY SHOWN IN SECTION

Figure 2-3. Video Cable CG-409E/U(8')

SECTION III

PREPARATION FOR USE AND RESHIPMENT

3-1. PREPARATION FOR USE.

3-2. Radio Test Set AN/URM-44 is supplied complete and is ready for use upon delivery. No permanent or special installation procedures are necessary. The test set should be checked to make certain that no damage has occurred during shipment. To prepare the test set for operation, proceed as follows:

a. Unlatch ten hooks from cover of transit case and lift cover from top of case. Cover is secured to case by chains.

b. Grasp signal generator by its two handles and lift out of transit case. Place signal generator on a work bench in any convenient position adjacent to the equipment to be tested, but outside of any direct strong r-f field.

c. Remove power cable CX-3135/U(8') from stowage compartment. Insert cable female connector into POWER INPUT receptacle on front panel and connect male connector to 115-volt, 50- to 1000-cycle per second, single-phase a-c power source. With the POWER switch in OFF, front-panel indicator lamp designated HEATER will be illuminated, indicating that equipment space heaters are in operation. If equipment has been subjected to excessive humidity, space heaters should be left on as long as practicable to dry out condensed moisture.

3-3 PRE-OPERATING CHECKS AND ADJUSTMENTS.

3-4. To determine whether equipment is in operating condition, check as follows:

a. Throw POWER switch to ON. HEATER lamp should go out indicating that space heaters are disconnected from power source. Front panel POWER lamp should light.

b. Allow test set to warm up for at least one minute so that internal time-delay relay can complete its cycle. This relay prevents application of high voltage to keyer and oscillator tubes until tube heaters have been energized for a full minute. BLOWER panel lamp should light during delay period and blower motor should be heard. Blower ventilates reflex-klystron oscillator tube. Shut down test set if blower motor is not operating.

c. Connect load to RF OUTPUT receptacle with r-f cable CG-92B/U(6').

3-5. Calibrate signal-generator output level as outlined below. (Refer to figure 1-2.)

a. Allow test set to warm up for at least 20 minutes, with POWER switch at ON and MODULATION SELECTOR at CW.

b. Adjust SIGNAL FREQUENCY control until dial shows desired operating frequency.

c. Make certain equipment under test is coupled to RF OUTPUT receptacle.

d. Turn MODULATION SELECTOR TO ZERO SET.

e. Adjust ZERO SET coarse (outer knob) and FINE contols carefully until pointer of the power-monitor meter deflects to left-hand index of scale, designated ZERO SET.

f. Turn MODULATION SELECTOR to CW.

g. Set OUTPUT ATTENUATOR control to desired value of r-f signal level, as shown under crossed hairlines of calibrated attenuator dial. This output level is expressed in decibels below one milliwatt, working into a resistive load of 52 ohms.

h. Adjust POWER SET control until pointer of power-monitor meter deflects to red-line calibration mark, indicating that r-f power output level may read directly from the attenuator-dial setting. If meter pointer cannot be deflected to zero-db calibration mark, actual level of r-f test signal at RF OUTPUT receptacle can be determined by algebraically adding meter-pointer indication to attenuator-dial indication. For example, if meter pointer remains deflected to plus 1 db mark after adjusting POWER SET control and output attenuator-dial indication is minus 54 dbm, correct output level of test signal at RF OUTPUT receptacle is minus 53 dbm (+1 db -54db).

3-6. RECALIBRATING POWER OUTPUT LEVEL.

3-7. If it becomes necessary during operation to change frequency setting of SIGNAL FREQUENCY control, power output level should be recalibrated, as follows:

a. Turn MODULATION SELECTOR to ZERO SET.

b. Adjust ZERO SET coarse and ZERO SET FINE until pointer of power-monitor meter deflects to left-hand index of the scale.

c. Turn MODULATION SELECTOR to CW.

d. Set OUTPUT ATTENUATOR control to desired value.

e. Adjust POWER SET control until pointer of the power-monitor meter deflects to red-line calibration mark. If a zero-db setting cannot be obtained, determine the actual level of r-f test signal at the RF OUTPUT receptacle by algebraically adding the output attenuator-dial reading to POWER SET meter reading.

3-8. PREPARATION FOR RESHIPMENT.

3-9. To prepare test set for reshipment, proceed as follows:

a. Remove power cord CX-3135/U(8') from power-source outlet and from POWER INPUT receptacle. Store cable in stowage compartment in transit case.

b. Disconnect r-f cable CG-92B/U(6') from any external equipment and from RF OUTPUT jack J13. Store r-f cable in transit-case stowage compartment.

c. If video cables CG-409E/U(8') are connected to any external equipment, disconnect them from that equipment and from SYNC EXT MOD jacks. Store cables in transit-case stowage compartment.

d. Grasp test set by its two handles and carefully lower it into main compartment of transit case. Place cover over case and latch ten hooks on body onto hooks on cover. The equipment is now ready for transit.

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION. (See figures 4-1 and 7-1.)

4-2. Signal Generator TS-622/U consists essentially of a modulator circuit, r-f reflex-klystron oscillator, power-monitoring bridge circuit, and four self-contained power supplies. The modulator generates a modulation voltage, either pulse or sawtooth in waveform, that is applied to the reflex-klystron oscillator tube. When pulse-modulation output is used, the signal from the modulator is applied to the grid of the klystron tube through a pulse amplifier and keyer circuit. When frequency modulation is used, the sawtooth signal from the modulator is applied directly to the repeller electrode of the klystron tube.

4-3. Provision is included for synchronizing this modulation voltage with an externally applied sine wave or pulse signal, of positive or negative polarity. When synchronization with an external source is not desired, the modulating voltage is generated by the pulse- or sawtooth-generator circuits. Provision is also included for making the internal modulator circuit inoperative while an external pulse-signal source is used to modulate the klystron oscillator tube.

4-4. In addition to producing an r-f test signal at the RF OUTPUT connector, the signal generator also produces video trigger signals for application to external equipment under test. At the UNDELAYED SYNC output jack, a positive polarity pulse of approximately one-microsecond duration, occurring coincident with the leading edge of the modulator trigger signal, is available. At the DELAYED SYNC output jack, a positive pulse of approximately one microsecond duration, occurring almost coincident with the leading edge of the r-f output test signal, is available. The setting of the PULSE DELAY control permits a delay of between 3 and 300 microseconds (with pulse repetition frequencies from 40 to 2500 pulses per second) between the generation of the r-f test signal and the modulator trigger signal. At pulse repetition frequencies higher than 2500 pps, the time delay is limited to 75% of the pulse period, as shown in figure 4-2.

4-5. The setting of the PULSE WIDTH control permits adjustment of the pulse duration of the internally modulated r-f test signal from 0.5 to 10 microseconds.

4-6. During c-w, f-m, or pulse-modulated operation, a portion of the r-f output from the klystron oscillator tube is applied to a self-contained power-monitor bridge circuit. By monitoring the oscillator output, an indication of r-f power at the RF OUTPUT connector, relative to a one-milliwatt reference level, can be obtained.

4-7. MODULATOR CIRCUIT.

4-8. Operation of the modulator circuit is controlled by settings of two front-panel controls designated SYNC SELECTOR S1 and MODULATION SELECTOR S3. Since all stages of the modulator (except for sawtooth generator and amplifier tube V5) function with MODULATION SELECTOR S3 at its INT position, paragraphs 4-9 through 4-26 below describe modulator operation with both SYNC SELECTOR S1 and MODULATION SELECTOR S3 in their INT positions. Paragraphs 4-27 through 4-30 describe pulse operation of the modulator when synchronized with externally applied sine waves (SIN position of S1), with externally applied negative polarity pulses ("-" position of S1), and with externally applied positive polarity pulses ("+" position of S1). Operation of the modulator with MODULATION SELECTOR S3 rotated to ZERO SET, CW, FM, EXT POS, and EXT NEG positions begins with paragraph 4-31.

4-9. MODULATOR OPERATION WITH SYNC SELECTOR S1 AND MODULATION SELECTOR S3 AT INT POSITIONS.

4-10. RATE MULTIVIBRATOR V6. (See figure 4-3.) Signal Generator TS-622/U functions as a self-triggered, self-synchronous pulse generator when SYNC SELECTOR S1 and MODULATION SELECTOR S3 are both set to their INT positions. Pulse repetition rate is determined by the settings of certain front-panel and chassis adjustment controls associated with the circuitry of rate multivibrator V6 functioning as a free-running pulse generator. Its period is determined by the value of capacitance (either C23 or C24) switched into the plate-to-grid circuit of tubes V6B and V6A by RATE MULTIPLIER selector S2B, and by the value of resistance set by PULSE RATE control R41B in series with 4000 PPS ADJ control R49 in the grid-to-cathode circuit of tube V6A. With RATE MULTIPLIER S2B rotated to X1 (C24 in circuit), the pulse rate is adjustable from 40 to 400 pulses per second by the setting of R41B. With RATE MULTIPLIER S2B at X10 (C23 in circuit), pulse rate is adjustable from 400 to 4000 pulses per second by R41B. The 40 PPS ADJ control R48 and the 4000 PPS ADJ control R49 are provided as calibration controls for setting both the low and high pulse-repetition-frequency limits accurately during servicing checks.

4-11. Plate voltage is supplied to V6 through pins 7 and 12 of A section of SYNC SELECTOR S1. When voltage is initially applied, the A section of V6 begins to conduct more heavily than the B section. V6A section grid (pin 7) is returned to cathode resistors through R41B and R49 and is, therefore, at a higher d-c potential than V6B grid (pin 2), which is returned directly to chassis ground. Since both cathodes (pins 3 and 8) are connected to common cathode resistors

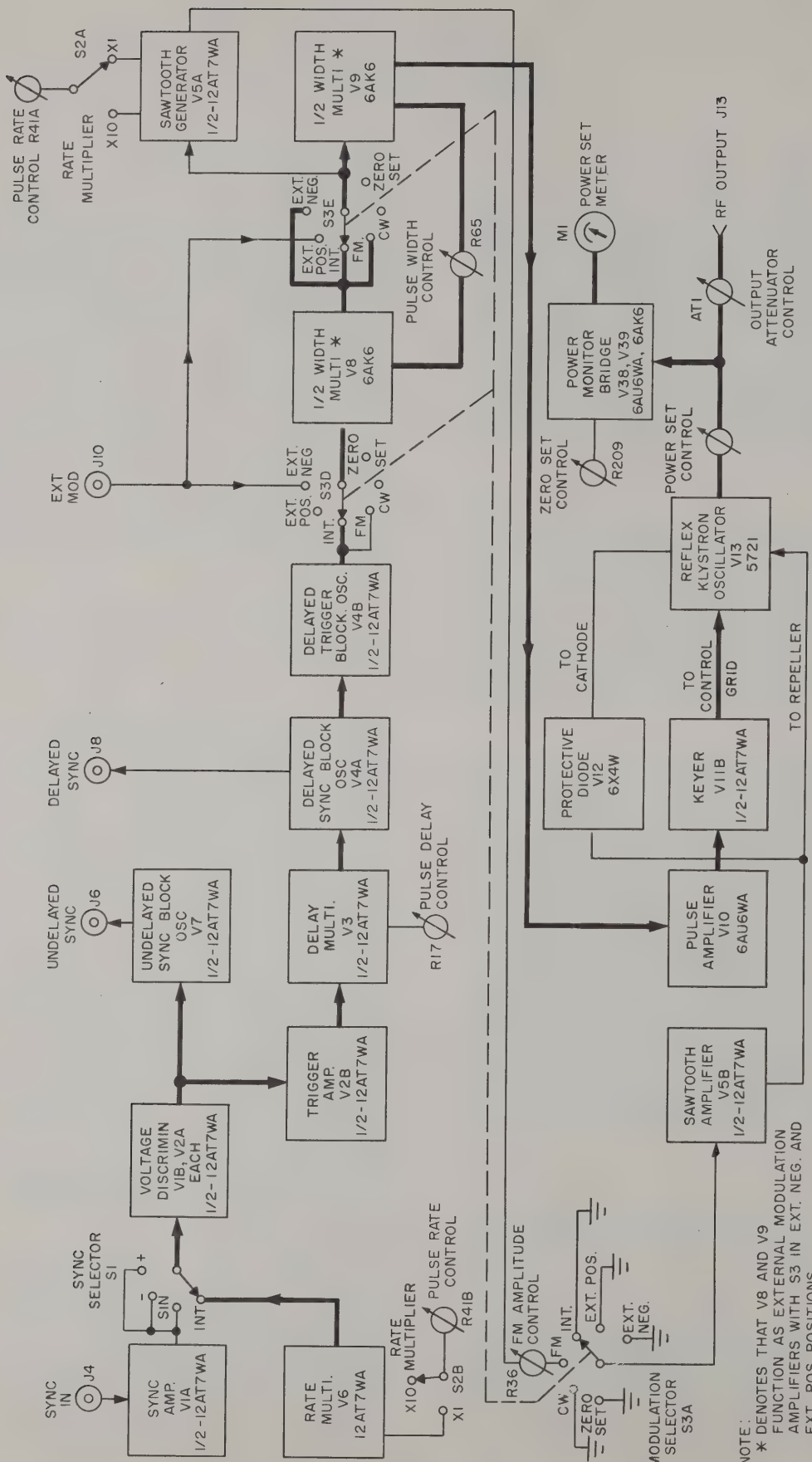


Figure 4-1. Signal Generator TS-622/U, Block Diagram

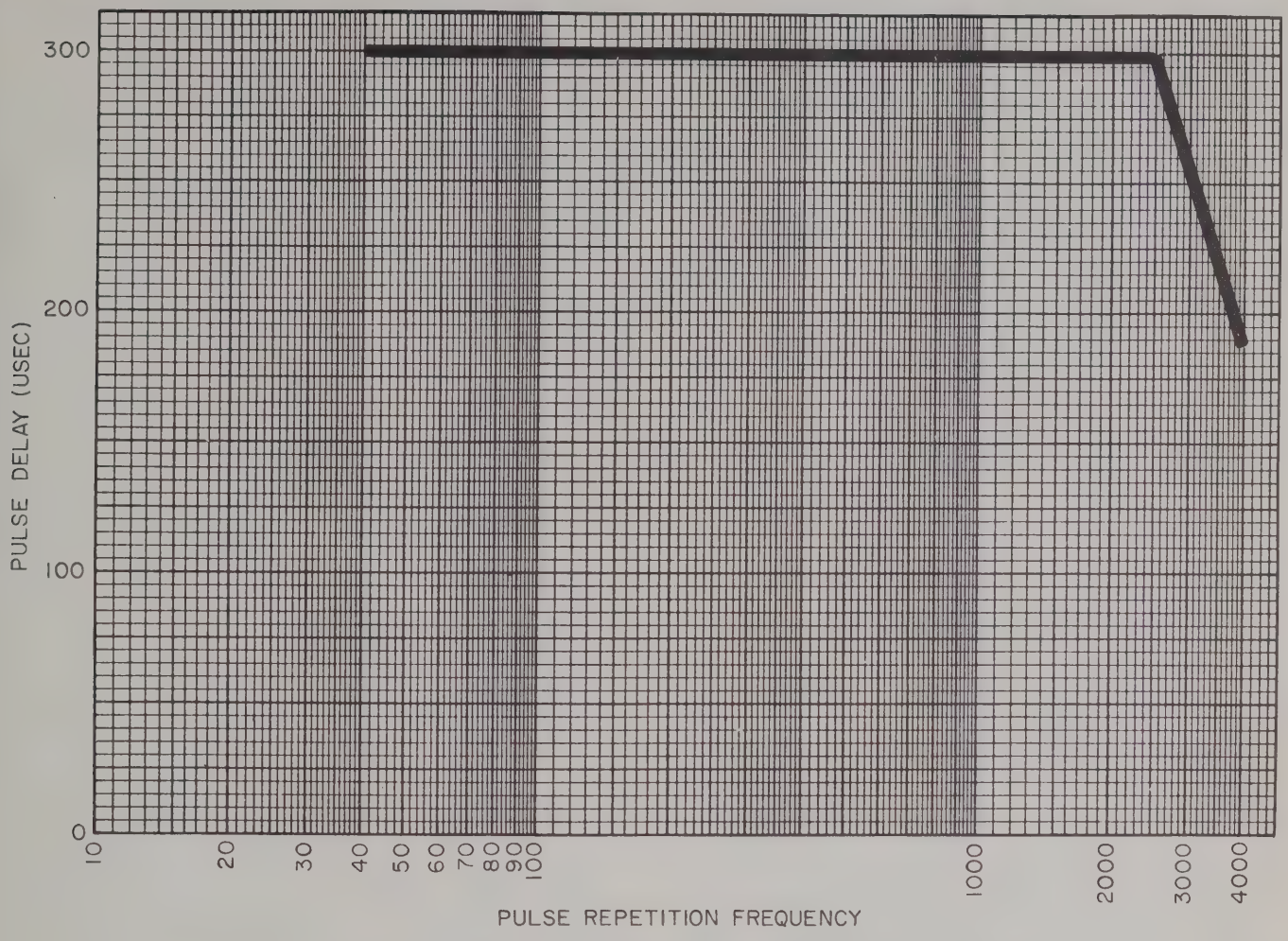


Figure 4-2. Maximum Pulse Delay at Selected Pulse Repetition Frequency

R47 and R48, the increase in current in A section of V6 raises the potential at cathode of B section. This positive-going voltage applied to the cathode of V6B produces the same effect as a negative signal on grid of V6B plate (pin 1). This positive plate signal, resulting from potential drop across load resistor R45, is coupled by C23 or C24 (whichever is in use) to grid of tube V6A, causing heavier conduction in this section, and producing a negative pulse at V6A plate (pin 6).

4-12. When the negative pulse is produced at V6A plate, a positive pulse is developed across series-connected cathode resistors R47 and R48. This increases amplitude of signal applied to V6B cathode (pin 3). The effect is the same as if a more negative signal were applied to V6B grid (pin 2), causing a further decrease in V6B plate current. The action is cumulative, until plate-current cutoff in V6B is reached.

4-13. With V6B plate current at cutoff, the voltage at V6B plate (pin 1) can no longer rise and the positive signal, which had been applied from plate of V6B through C23 (or C24) to grid (pin 7) of V6A, is removed. This lowers V6A plate current and causes a decrease in cathode potential at pins 3 and 8. The decrease in cathode potential of V6B is the same as an increase in signal potential at its grid (pin 2), and the B section of the tube now begins to conduct.

4-14. Conduction in V6B initiates a negative-going voltage at its plate (pin 1). This changing voltage is coupled by C23 (or C24) to the grid (pin 7) of V6A and decreases both its plate current and the potential across the common cathode resistors. This regenerative action causes section B of the tube to conduct more heavily, while section A is well beyond cutoff. This condition remains until C23 (or C24) discharges sufficiently to allow V6A to conduct again. The cycle is repeated continually as long as SYNC SELECTOR S1 and MODULATION SELECTOR S3 are at INT. The rate of discharge of C23 (or C24) is determined by the time-constant network consisting of either capacitor in series with PULSE RATE control R41B and 4000 PPS ADJ control R49.

4-15. For each conducting period of V6A, a rectangular pulse of negative polarity is produced at its plate (pin 6). This negative pulse is applied via coupling capacitor C22 and the C section of SYNC SELECTOR

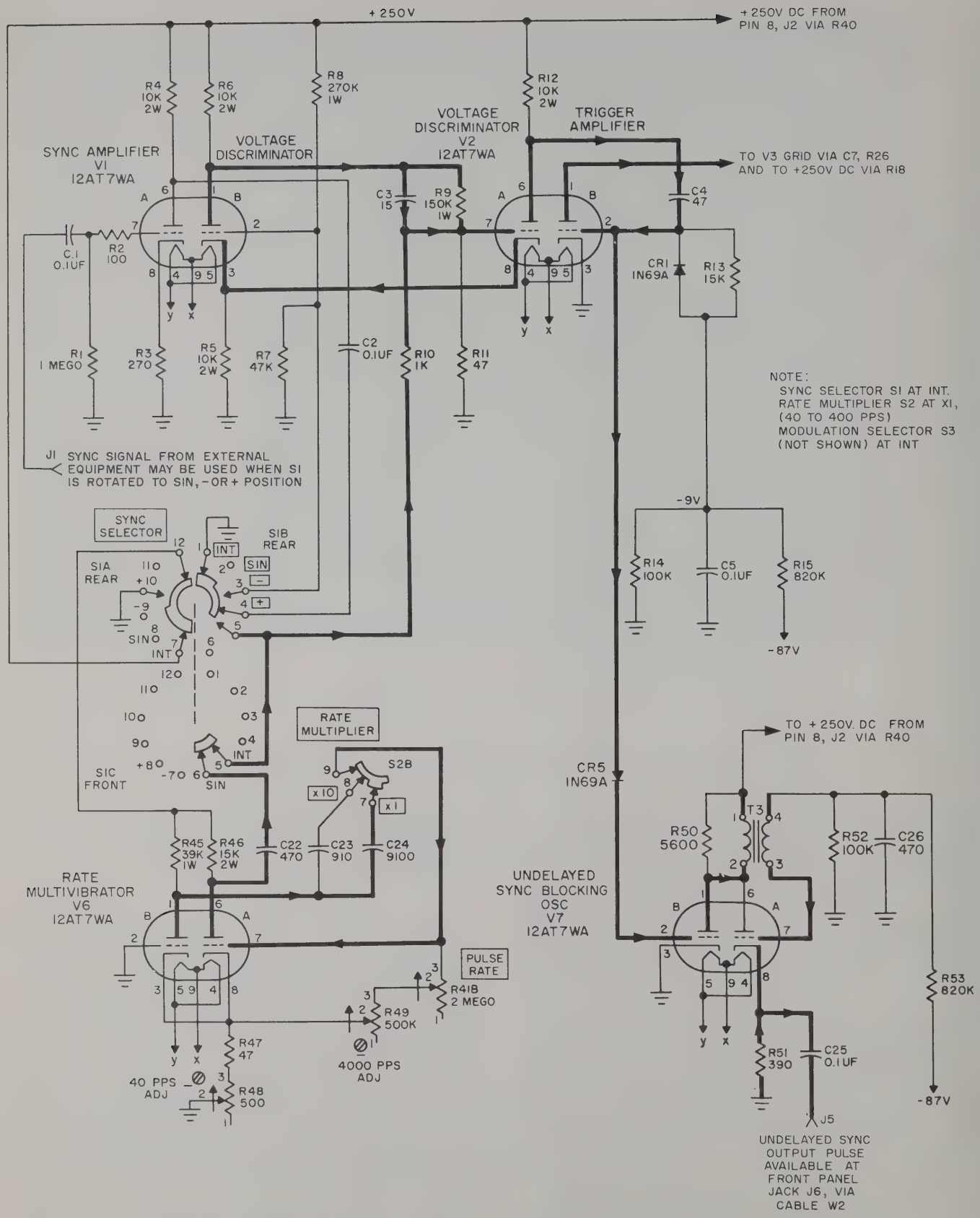


Figure 4-3. Modulator Trigger and Sync Pulse, Simplified Schematic

S1 (pins 6 and 5) to the grid of voltage discriminator V2.

4-16. VOLTAGE DISCRIMINATOR V1B and V2A. (See figure 4-3.) The B section of VI and the A section of V2 are employed as the voltage-discriminator stage. The cathode of V2A is connected to the cathode of V1B and, through common cathode resistor R5, to chassis ground. When the negative pulse output from the plate of multivibrator V6A is applied to the grid (pin 7) of V2A, plate current is cut off in this section. A pulse of negative polarity is developed across common cathode resistor R5. The grid of V1B (pin 2) is maintained at a positive potential by its connection to the junction of voltage-divider resistors R7 and R8 shunted across the positive 250-volt supply line. The negative pulse developed across V1B cathode resistor R5 produces the same result as would a positive pulse applied to its grid (pin 2) and the plate current of V1B is increased. The current increase through plate load resistor R6 develops a negative pulse at the plate (pin 1). This pulse is coupled through C3 and shunting resistor R9 to the grid (pin 7) of V2A and reinforces the negative pulse originally received at V2A grid from the multivibrator. By driving V2A to plate-current cutoff for the duration of each multivibrator pulse output, constant-amplitude positive pulses are developed across its plate load resistor R12. These positive pulses are coupled by C4 to the grid of trigger amplifier V2B, and through crystal rectifier CR5 to the undelayed sync blocking oscillator V7.

4-17. TRIGGER AMPLIFIER V2B (See figure 4-3.) The B section of V2 is utilized as trigger amplifier. Its plate (pin 1) is connected to the positive 250-volt supply line through load resistor R18, while its cathode (pin 3) is connected to chassis ground. Its control grid (pin 2) is maintained at a negative potential of approximately 9 volts by connection through R13 to the junction of voltage-divider resistors R14 and R15 in the bias supply line. The positive pulses developed across V2A plate load resistor R12 are applied to the differentiating network C4 and R13. The sharp positive pulse which results from differentiation is coupled to the grid (pin 2) of trigger amplifier V2B. Crystal rectifier CR1 functions to supress the negative polarity overshoot from reaching the grid. The amplified negative plate pulse developed across load resistor R18 is coupled by C7 to the grid delay multivibrator V3.

4-18. UNDELAYED SYNC BLOCKING OSCILLATOR C7. (See figure 4-3.) Blocking oscillator coil T3 is connected in the plate-to-grid circuit of the A section. The plates (pins 1 and 6) are tied together and connected through R50 and the primary winding of T3 to the positive 250-volt line. The cathode (pin 3) of the B section is grounded while the cathode (pin 8) of the A section is returned to ground through cathode load resistor R51. The B section grid (pin 2) is connected directly to crystal rectifier CR5 while the A section grid (pin 7) is maintained at a negative potential through its connection to the junction of voltage-divider resistors R52 and R53 in the minus 87-volt bias supply. In the absence of a signal, the A section is at cutoff. The positive pulse from the grid of V2B is coupled by CR5 to the grid (pin 2) of the oscillator, and causes V7B to conduct. One portion of its resultant plate current flows through R50, while another portion flows through T3 primary winding (terminals 1 and 2). During this change in plate current, a voltage is induced in the secondary winding (terminals 3 and 4) of T3 of such polarity as to apply a positive signal to the grid of V7A. The amplitude of this positive signal is sufficient to overcome the fixed bias applied to the grid (pin 7) and conduction starts in V7A. This increases the current flowing through the primary winding of T3 and induces a greater positive voltage in the secondary winding connected to V7A grid. The action is cumulative to the point of plate-current saturation in V7A. When this level of conduction is reached, the current through the primary winding of T3 can no longer increase and a voltage is no longer induced in the secondary winding of the coil. Consequently signal potential is removed from the grid (pin 7) and V7A plate current is reduced. The decreasing plate current now induces a voltage in the secondary winding of T3 of such polarity that a negative-potential signal is applied to the grid of V7B, and plate-current cutoff is rapidly reached. During the conducting period, a positive pulse, with rise and decay times less than one microsecond in duration, is developed across cathode resistor R51. This pulse is coupled through C25 to the connector J5 on the modulator chassis. Internal coaxial cable W2 is connected from the modulator chassis to the front-panel UNDELAYED SYNC output jack J6. Pulses of approximately one-microsecond duration, with a minimum amplitude of positive 25 volts and with a repetition rate identical to that of the rate multivibrator V6, are available at J6 for application as sync trigger pulses for external equipment.

4-19. DELAY MULTIVIBRATOR V3. (See figure 4-4.) In the absence of a signal, V3B is normally conducting since its grid (pin 2) is connected through R26 and R27 to the positive 250-volt supply line. Conduction of V3B raises the cathode potential (pins 3 and 8) above ground potential. V3A is maintained at cutoff in the absence of a signal. Its grid (pin 7) is connected through PULSE DELAY control R17 and resistor R16 to the positive 108-volt supply line. At the extreme counterclockwise setting of R17, V3A grid (pin 7) is at ground potential.

4-20. The negative pulse from the plate of trigger amplifier V2B is coupled by C7 to the grid (pin 2) of V3B and is sufficient in amplitude to cut off V3B plate current. The decreased current flow through common plate resistors R21 through R23 results in a positive pulse at V3B plate (pin 1) while a negative pulse is started across common cathode resistors R24 and R25. The effect of this negative-going voltage at the cathode of V3A is the same as if a positive pulse were applied to its grid (pin 7), and plate current begins to flow in the A section. Adjustment of the ADJUST DELAY control R25 in the cathode circuit alters the level of conduction in V3A.

4-21. Current flow through V3A and its plate load resistor R18 reduces plate potential (pin 6). This negative-going voltage is coupled by C7 to the grid (pin 2) of V3B, and causes plate-current cutoff in the B section. Capacitor charge decays at a rate determined by the time constant of C7 and R27. When C7

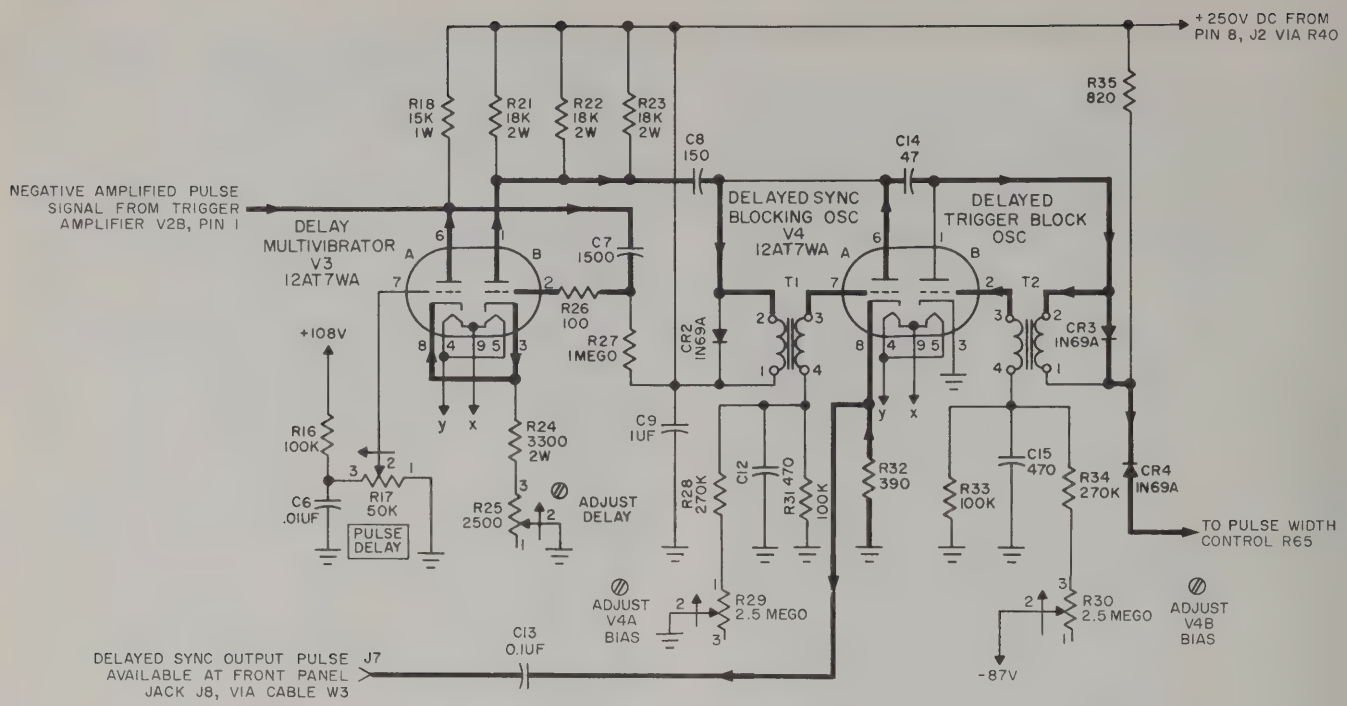


Figure 4-4. Modulator Delay Multivibrator, Delayed Sync, and Delayed Trigger Pulse, Simplified Schematic

has discharged to a critical potential, section B begins to conduct again.

4-22. The time required for V3B to recover and conduct again depends on the magnitude of the negative pulse applied to its grid (pin 2) from the plate of V3A. The setting of PULSE DELAY control R17 determines the level of conduction of tube V3A and, therefore, the amplitude of the negative pulse at its plate.

4-23. With V3B conducting, the cathode potential rises at pins 3 and 8, common to both sections of the tube, and conduction of V3A falls. As a result, the voltage at V3A plate (pin 6) increases. This positive-going voltage is coupled to the grid of V3B by C7 and increases still further the flow of the plate current in the B section. The regenerative action proceeeds until V3A is once again cut off and the multivibrator returns to its quiescent state, awaiting the application of the next pulse from trigger amplifier V2B. While V3B was at cutoff, a positive pulse was produced at its plate (pin 1). This output pulse, the duration of which is determined by the setting of front-panel PULSE DELAY control R17, is coupled by C8 to the primary winding of blocking oscillator coil T1 to activate delayed sync blocking oscillator V4A.

4-24. DELAYED SYNC BLOCKING OSCILLATOR V4A. (See figure 4-4.) The plate (pin 6) of V4A is connected through terminals 2 and 1 of blocking-oscillator coil T1 to the positive 250-volt supply line. The grid (pin 7) is connected through terminals 3 and 4 of T1 to a negative potential of approximately 9 volts, determined by the value of the voltage divider consisting of fixed resistors R31, R28, and variable resistor R29. ADJUST V4A BIAS control R29 is preset for proper grid bias. The cathode (pin 8) of V4A is connected through load resistor R32 to chassis ground. In the absence of a signal, section A of V4 is normally non-conducting due to the grid bias voltage. When a pulse from delay multivibrator V3 is applied to the differentiating network consisting of C8 and the primary winding of coil T1, the positive leading edge of this pulse is suppressed by crystal rectifier CR2 and filter capacitor C9. After differentiation, the trailing edge of the pulse appears as a sharp negative waveform of extremely short duration across the primary winding (terminals 1 and 2) of T1. By transformer action, this signal is inverted into a sharp positive pulse at terminal 3 of T1, with an amplitude sufficient to overcome the grid bias potential. As soon as conduction in V4A starts, the potential at its plate (pin 6) begins to fall. This negative-going voltage at terminal 2 of T1 (the plate load of the tube) reinforces the negative pulse resulting from differentiation of the delay-multivibrator output, and a signal of greater positive amplitude is induced in the secondary winding of T1. V4A plate potential is further reduced, with a cumulative effect up to the point of plate-current saturation. Once started, operation of the blocking oscillator is independent of the trigger pulse which originally initiated conduction. With plate-current saturation reached, the magnetic field of T1 collapses. The effect is again cumulative, and a very rapid decay of the pulse takes place. Coincident with the negative plate pulse, a positive pulse is produced across cathode resistor R32. This pulse is coupled by C13 to connector J7 on the modulator chassis. Through internal coaxial cable W3, the positive pulse is available at front-panel DELAYED SYNC jack J8 for application to external equipment. This sync output pulse may be utilized as a delayed trigger pulse.

4-25. DELAYED TRIGGER BLOCKING OSCILLATOR V4B. (See figure 4-4.) Tube V4B is normally non-

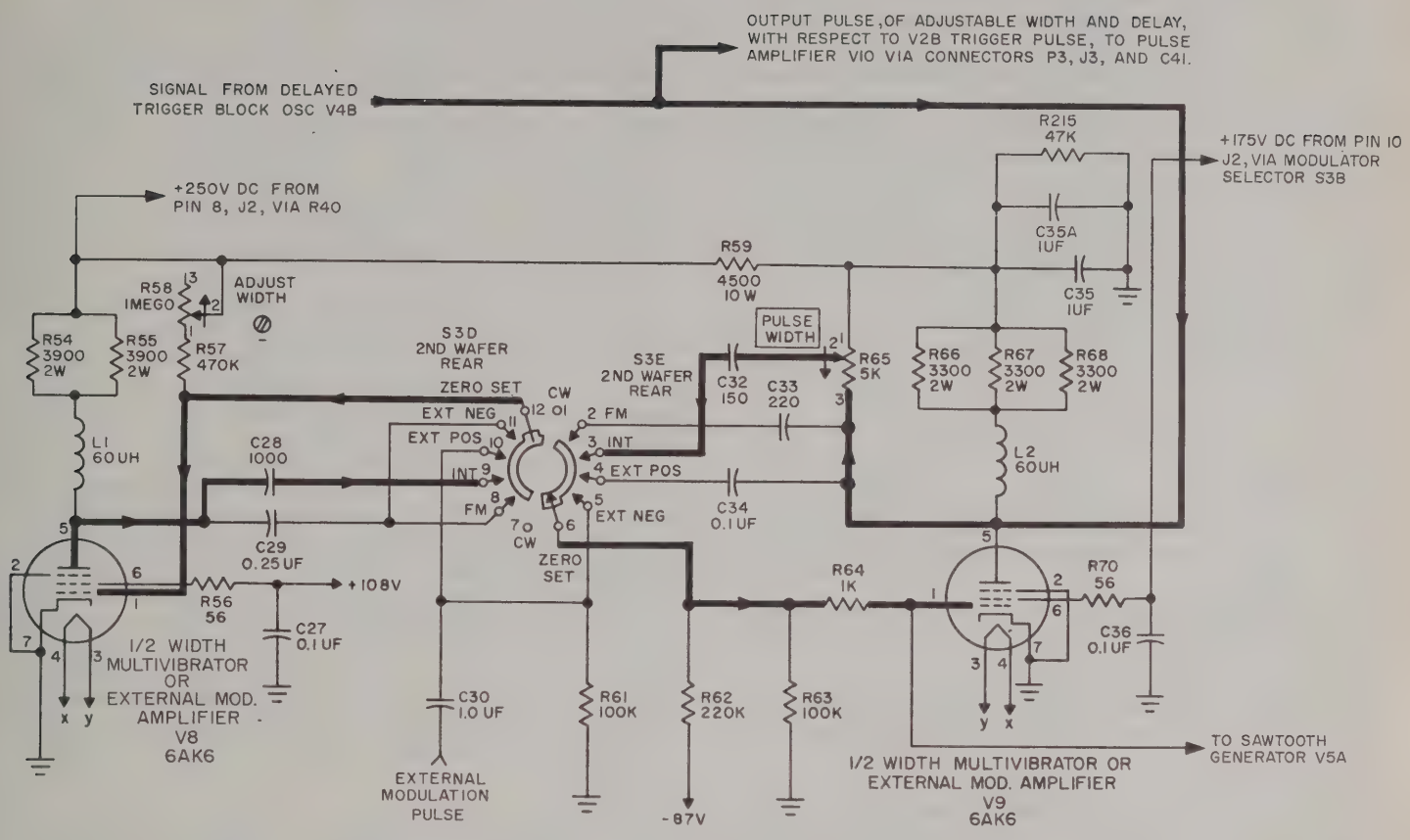


Figure 4-5. Modulator Pulse-Width Multivibrator, Simplified Schematic

conducting since its grid (pin 2) is connected to the junction of the voltage divider consisting of fixed resistors R33 and R34 and variable resistor R30. ADJUST V4B BIAS control R30 is preset for proper bias potential at the grid of V4B. The cathode (pin 3) is grounded, while the plate (pin 1) is connected to the positive 250-volt supply line through the primary winding (terminals 1 and 2) of blocking-oscillator coil T2 and resistor R35. The negative pulse produced at the plate (pin 6) of V4A is coupled by C14 to the primary of T2. A potential is induced in the secondary winding (terminals 3 and 4) of T2 of such polarity as to apply a positive signal to the grid (pin 2) of V4B. As soon as conduction begins, a negative pulse is produced at the plate of V4B. This negative signal is fed to the primary winding of T2 and furthers the action. The effect is cumulative to the point of V4B plate-current saturation when a sharp pulse decay results. Crystal rectifier CR3 is connected across the primary winding of T2 to suppress ringing for more than one cycle. The negative pulse from the primary of T2 is coupled through crystal rectifier CR4, PULSE WIDTH control R65, capacitor C32, and the D and E sections of MODULATION SELECTOR S3 for application to the pulse-width multivibrator stage V8 and V9.

4-26. PULSE-WIDTH MULTIVIBRATOR V8 and V9. (See figure 4-5.) The pulse-width multivibrator stage is operative with SYNC SELECTOR S1 at INT. The plates (pins 5) of V8 and V9 are each connected through peaking coils L1 and L2 respectively and dropping-resistor networks to the positive 250-volt line. The screen grid (pin 6) of V8 is permanently connected through R56 to the positive 108-volt supply. The screen grid of V9 is connected through R70 and MODULATION SELECTOR S3B (pins 1 and 11) to the positive 175-volt supply. The control grid (pin 1) of V8 has a high positive potential applied, through R57 and ADJUST WIDTH control R58, by the positive 250-volt supply. The control grid of V9 is maintained at a negative potential, through voltage-divider resistors R62 and R63, by the minus 87-volt bias supply. Both cathodes are at ground potential. V8 is normally conducting, in the absence of a signal, while V9 is at cutoff. When the negative pulse from the plate of blocking oscillator V4B is applied to the control grid of V8 (through PULSE WIDTH control R65, C32 and pins 3 and 12 of MODULATION SELECTOR S3D), the tube is cut off for a period of time. The positive pulse at the plate of V8 is coupled (through C28 and pins 9 and 6 of MODULATION SELECTOR S3E) to the control grid of V9. This positive pulse

is sufficient in amplitude to cause conduction in V9. A negative pulse is produced across its plate-load network consisting of peaking coil L2 and shunt resistors R66 through R68. This negative pulse reinforces the applied signal from the blocking oscillator V4B and maintains V8 at cutoff for a duration of time determined by the time constant circuit R65, C32, and series resistors R57 and R58. The negative pulse at the plate of V9 can be adjusted by front-panel PULSE WIDTH control R65 for a 0.5 to 10-microsecond duration. The negative pulse, with a duration set as desired, is coupled by internal coaxial cable W5 from the plate (pin 5) of V9 to connector P3. When connected to its mating jack J3 on the keyer chassis, this signal activates the pulse amplifier and keyer circuits that produce pulse-modulated r-f test signals.

4-27. MODULATOR OPERATION WITH SYNC SELECTOR AT SIN, "-" AND "+" POSITIONS.

4-28. MODULATION SELECTOR S3 AT INT AND SYNC SELECTOR S1 AT SIN. (See figures 4-1 and 4-3.) With SYNC SELECTOR S1 at SIN position, the modulator may be synchronized with an external sinusoidal voltage coupled to SYNC IN jack J4 and fed through W1, P1, J1 and C1 to sync amplifier V1A. The amplified signal is coupled by C2 and the B section of SYNC SELECTOR S1 to the grid of voltage discriminator V1B. V1B with V2A produce a negative plate pulse, as described in paragraph 4-16. The action of each of the succeeding stages in the modulator is identical to that described in preceeding paragraphs.

4-29. MODULATION SELECTOR S3 AT INT AND SYNC SELECTOR AT "-". (See figures 4-1 and 4-3.) With SYNC SELECTOR S1 rotated to "-", operation of the modulator circuit is the same as that described in paragraph 4-28 for SIN position. The negative synchronizing pulse is applied through C1 to the grid of V1A, producing the same effect as the negative half-cycle of a sine-wave sync signal.

4-30. MODULATION SELECTOR S3 AT INT AND SYNC SELECTOR S1 AT "+." (See figures 4-1 and 4-3.) With SYNC SELECTOR S1 at "+", the modulator may be synchronized with external positive pulses applied to SYNC IN jack J4. The positive pulse applied to the grid of V1A produces a negative plate pulse. This negative pulse is coupled through C2 and the B section of SYNC SELECTOR S1 to the grid of voltage discriminator V2A. Operation of the succeeding stages is identical to that previously described.

4-31. OPERATION WITH MODULATION SELECTOR AT ZERO SET, CW, FM, AND EXT POSITIONS.

4-32. MODULATION SELECTOR S3 AT ZERO SET POSITION. (See figure 4-6.) With MODULATION SELECTOR S3 at ZERO SET, the negative 1358-volt potential from the keyer power supply is applied to the cathode of pulse amplifier V10, allowing the tube to conduct. This causes a negative potential to be developed at the junction of R83 and the grid (pin 2) of keyer V11. The grid of the reflex-klystron oscillator tube V13 is directly connected to the cathode (pin 3) of keyer V11. Since less current flows in V11 when V10 conducts, the cathode potential of V11 is lowered to approximately negative 1260 volts with respect to chassis ground. Since the cathode of klystron V13 is tied to a fixed potential of negative 1250 volts, this grid potential of negative 1260 volts is below the oscillation level of the klystron so that the tube is cut off whenever selector S3 is rotated to ZERO SET. In addition, switch sections S3A and S3B ground the screen grid (pin 6) of width multivibrator V9 (figure 4-5). The control grid (pin 2) of sawtooth amplifier V5B is grounded through action of switch section S3A (figure 4-7). Switch sections S3D and S3E disconnect the control grids (pins 1) of width multivibrator V8 and V9 from any signal path. Under all these circumstances, no pulses can be applied to pulse amplifier V10.

4-33. MODULATION SELECTOR S3 AT CW POSITION. (See figure 4-6.) With MODULATION SELECTOR S3 at its CW position, pulse amplifier V10 is open-circuited. Its path to the negative 1358-volt potential from the keyer supply is broken by switch section S3C. Under this condition, the cathode of keyer V11 rises to a potential of approximately negative 1240 volts, which is 10 volts more positive than the potential of klystron V13 cathode. The negative 1240-volt potential is applied directly to the control grid of V13 and the tube oscillates, producing r-f output test signals, without modulation. To assure that no signal will be applied to the oscillator from the modulator, switch sections S3A and S3B apply ground potential to the screen grid (pin 6) of pulse-width multivibrator V9. The control grids of both V8 and V9 are disconnected from the signal path and the grid of sawtooth amplifier V5B is grounded through switch section S3A.

4-34. MODULATION SELECTOR S3 AT FM POSITION. (See figures 4-5 and 4-7.) The equipment may be synchronized with any of three suitable types of input sync signals, or it may be triggered internally, according to the setting of SYNC SELECTOR S1. Operation is the same as that for pulse modulation up to the point of the control grid (pin 1) of width multivibrator V9. At the junction of this grid and R64, the positive pulse from tube V8 in the multivibrator circuit is tapped and applied to the grid (pin 7) of sawtooth amplifier V5A. During this positive pulse, section A of the tube conducts heavily, discharging C17 or C18 (whichever is in the circuit through RATE MULTIPLIER S2A). In the interval between positive pulses, section A of the tube is cut off, and C17 (or C18) is charged through R42 and PULSE RATE control R41A. This results in a voltage across C17 (or C18) which rises exponentially. The circuit is designed so that the linear portion of this charging potential is utilized. Section B of V5 is an amplifier with FM AMPLITUDE control R36 in its grid circuit. Transmission of the sawtooth wave from section B is through R36. At maximum amplitude, reflex-klystron oscillator V13 is driven out of the mode so that the large amplitude available affords easy observation of the klystron mode plot on a high-gain oscilloscope with a minimum of accessory equipment.

4-35. PULSE AMPLIFIER V10 AND KEYER V11 CIRCUIT. (See figure 4-6.)

4-36. Both pulse amplifier V10 and keyer V11 are transitional stages between the modulator circuit and

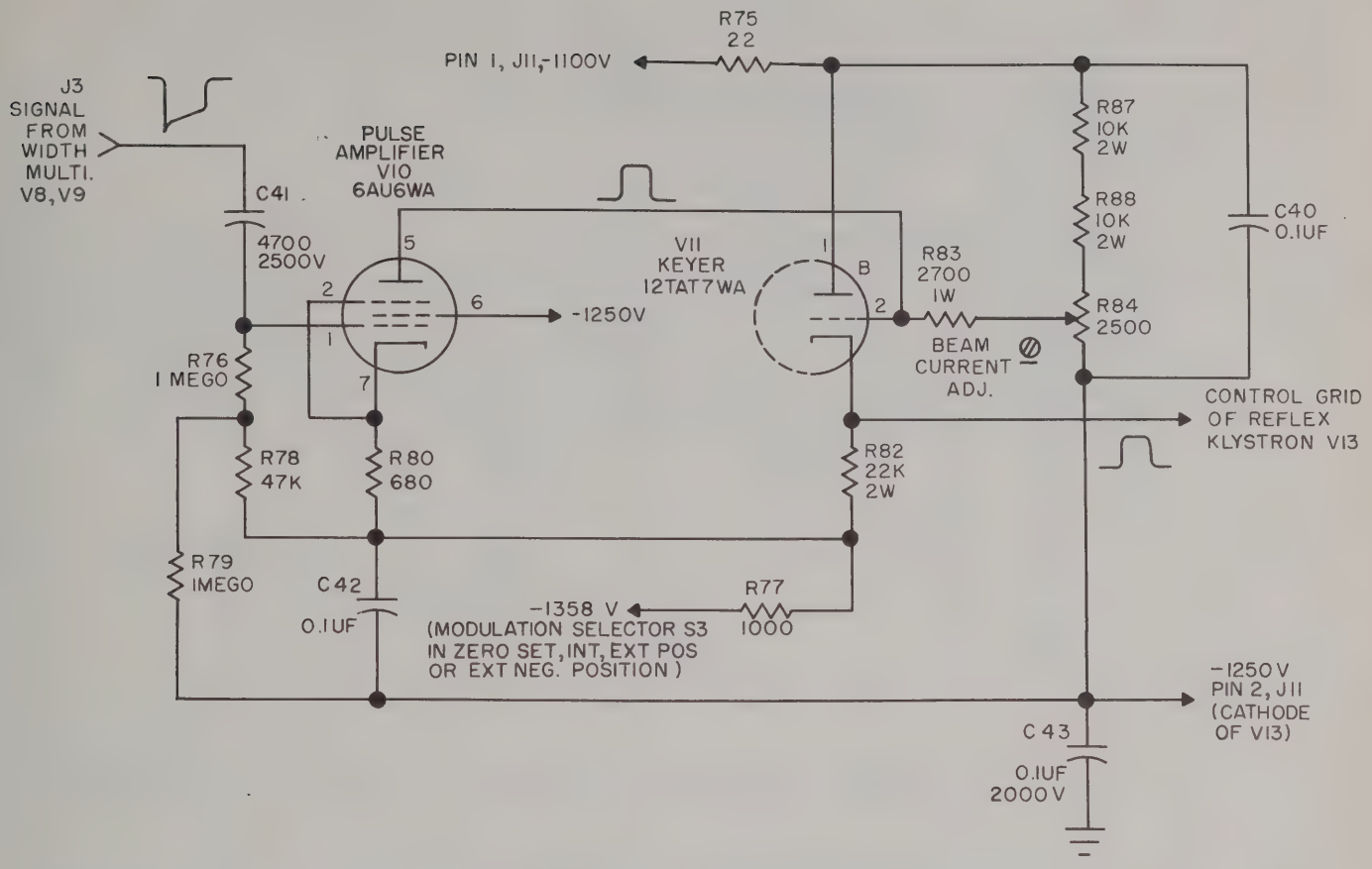


Figure 4-6. Pulse Amplifier and Keyer, Simplified Schematic

the reflex-klystron oscillator tube. The cathode of V10 (pin 7) and the cathode of V11 (pin 3) are connected to a potential of negative 1358 volts through resistors R80, R82, and common resistor R77. The plate of V10 (pin 5) derives its d-c potential from the grid of V11 (pin 2). The grid of V11 is connected through R83 to BEAM CURRENT ADJ R84, part of a bleeder circuit between negative 1100 volts and negative 1250 volts. This bleeder consists of four resistors in series, R75, R87, R88, and R84. The plate output of width multivibrator V9 is coupled through cable W5, P3, J3, and C41 to the control grid of pulse amplifier V10. The control grid is tied to the cathode of the same tube (pin 7) through series resistors R76, R78, and R80. A potential of negative 1250 volts is fed to the junction of R76 and R78 through R79. Capacitors C40, C42, and C43 by pass the circulating pulse currents so that the quiescent d-c conditions of the circuit are not affected. For certain positions of MODULATION SELECTOR S3, V10 is made inoperative by open-circuiting the negative 1358-volt potential from the cathode (pin 7). For the ZERO SET, INT, EXT POS, and EXT NEG positions of MODULATION SELECTOR S3, contact is made between terminals 4 and 5 of switch S3C. In these switch positions, the negative 1358 voltage is returned to the cathode circuit of V10 and V11 via pins 6 of connectors J2 and P2. However, for CW and FM positions of switch S3C, this circuit is broken. Keyer stage VII conducts because of the potential difference established by the negative 1100 volts applied to its plate (pin 1) through R75 and the negative 1250 volts applied to its cathode (pin 3) through R79, R78, and R82. Since the setting of R84 controls the d-c current through V11 and, therefore, the potential both at its cathode and the control-grid of klystron oscillator tube V13, R84 sets the beam current of the klystron to the desired value. This is accomplished by setting R84 so that the cathode potential of keyer V11 is at approximately negative 1240 volts for oscillation of the klystron cavity.

4-37. When MODULATION SELECTOR S3 is rotated to FM, a sawtooth voltage from sawtooth generator and amplifier V5 is applied through pins 5 of connectors J2 and P2 and through pins 3 of connectors J12 and P12 to coupling capacitor C45. This capacitor feeds the sawtooth voltage directly to the repeller electrode of reflex-klystron oscillator V13. Oscillator output is then frequency modulated at a deviation dependent on the setting of FM AMPLITUDE control R36 in the grid circuit of sawtooth amplifier V5B.

4-38. When MODULATION SELECTOR S3 is at ZERO SET, INT, EXT POS, or EXT NEG, the negative 1358 volts is applied to the cathode circuits of V10 and V11. Application of this voltage causes pulse amplifier V10 to conduct, since its cathode is then negative with

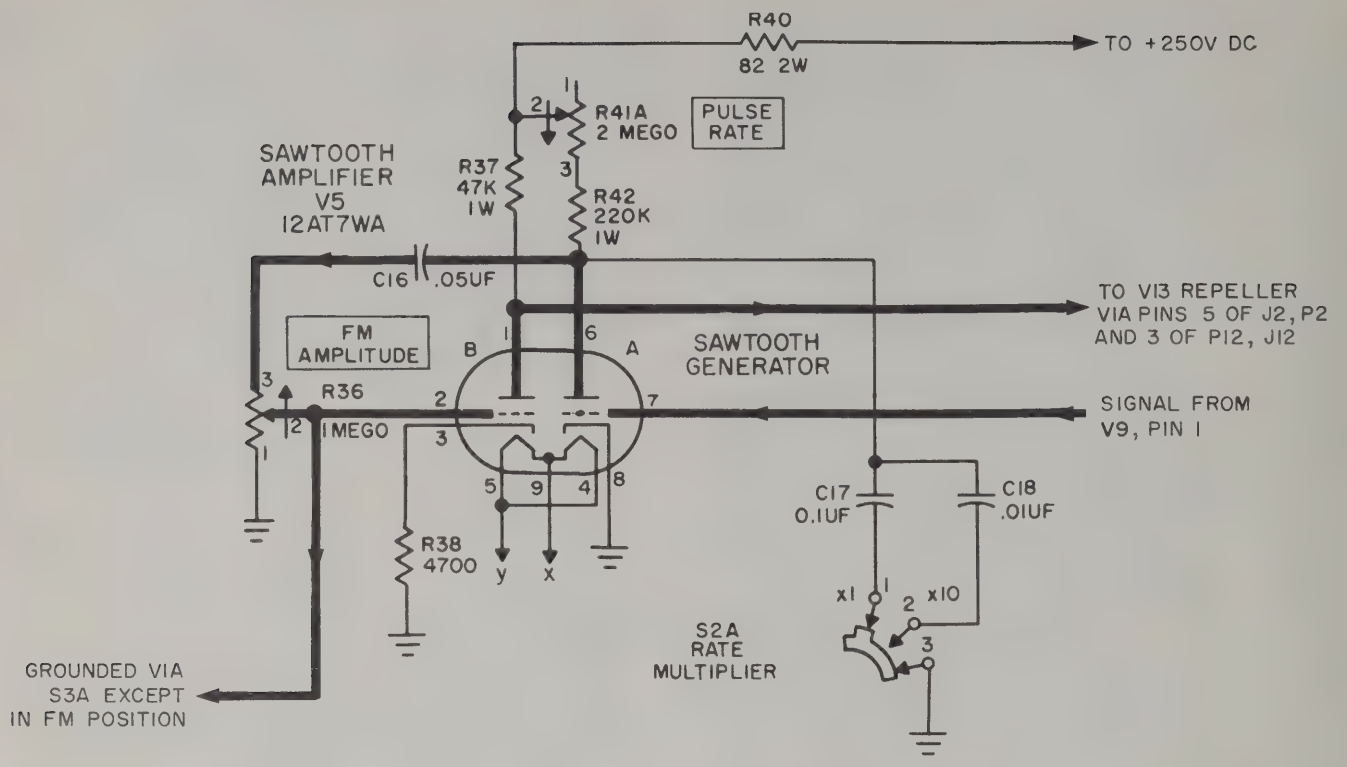


Figure 4-7. Sawtooth Generator and Amplifier, Simplified Schematic

respect to its plate. As plate current of V10 is drawn from the bleeder network through R83, the potential of the grid of keyer V11 is reduced. This reduces the plate current of V11 and lowers the potential drop across its cathode resistor R82. The control grid of reflex klystron V13, which is connected to the cathode of V11, is brought down to approximately negative 1260 volts. This causes klystron oscillations to cease since its cathode is maintained approximately 10 volts more positive than its grid. With no microwave power produced by the klystron oscillator, the power-monitor bridge can be balanced when MODULATION SELECTOR S3 is at its ZERO SET position.

4-39. When S3 is rotated to INT, EXT POS, or EXT NEG, negative pulses are applied to the control grid of pulse amplifier V10, causing plate-current cutoff in V10 for the duration of each pulse. During this cutoff period, the circuit operates identically as it does in CW position of the S3. Therefore, power output and frequency of the klystron oscillator for the pulse duration is the same as that set for the CW position, except that pulse-modulated microwave output is produced.

4-40. In the INT position of S3, the pulse is generated by the self-contained modulator circuit, with its duration controlled by the setting of PULSE WIDTH control R65, its repetition frequency determined by the setting of RATE MULTIPLIER S2B and PULSE RATE control R41B, and its delay (with respect to the leading edge of the modulator trigger pulse) determined by the setting of PULSE DELAY control R17. When external pulses are employed to modulate the klystron oscillator, the four front-panel controls have no effect, the duration and repetition frequency of the r-f test signal being entirely dependent on the characteristics of the externally applied signal, which is connected through EXT MOD jack J10.

4-41. In the EXT POS position of S3, V9 operates as an amplifier and the connection between V8 and V9 is broken.

4-42. In the EXT NEG position of S3, incoming pulses are initially applied through pins 5 and 12 of switch section S3D, are inverted by V8, and are then coupled by pins 11 and 6 of switch section S3E to V9. The positive pulses at the grid of V9 are amplified and inverted for delivery to the control grid of the pulse amplifier V10, where operation is identical to that of the INT position of MODULATION SELECTOR S3.

4-43. KLYSTRON OSCILLATOR CIRCUIT.

4-44. GENERAL. (See figures 4-8 and 7-1.) R-F oscillator tube V13 generates the r-f power for delivery to the external equipment under measurement. The velocity-modulation tube, type 5721, operates with an external resonant cavity. The resonant L and C of the cavity Z2 connect to two tube electrodes, termed resonator grids. The resonator grids of the tube are separated from the cathode by an accelerator grid. The repeller electrode, on the opposite side of the resonator grids from the accelerator grid, is at a high negative potential so that it can repel the electron stream. The cathode of V13 is fixed at minus 1250 volts, while the repeller voltage can vary from minus

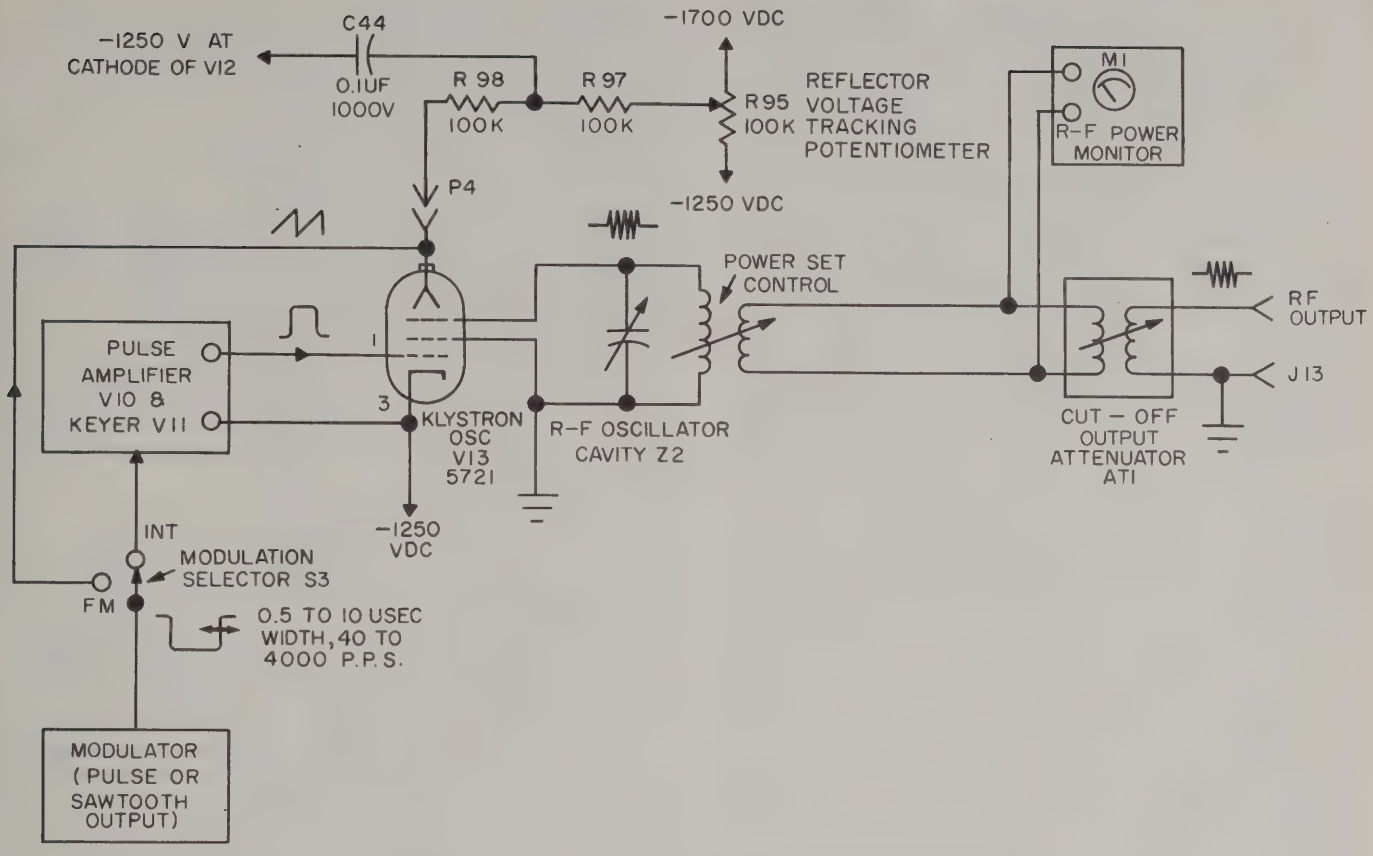


Figure 4-8. Klystron R-F Oscillator, Equivalent Circuit

1250 volts down to minus 1700 volts. (See figure 4-9.) The resonator grids and the accelerator grid are of relatively coarse open construction so that electrons can easily pass through them when electrical potentials are of the proper magnitude and polarity.

4-45. KLYSTRON CAVITY. The cavity employed is in the form of a coaxial transmission line consisting of two cylinders, one inside the other. The klystron tube is inserted at one end of this line so that the outer cylinder makes contact with the first interaction grid while the inner cylinder makes contact with the second interaction grid. At the other end, the circuit is completed by a movable non-contacting shorting plunger. The position of this movable short determines the resonant frequency of the cavity. If the short is somewhat less than an odd multiple of a quarter-wavelength away from the interaction grids, the cavity presents a high impedance to the tube at the corresponding frequency, and is equivalent to an anti-resonant circuit. The movable short is always less than an odd multiple of a quarter-wavelength away, because of the capacitive loading produced by the interaction grids. The loading permits the cavity to be physically shorter than would otherwise be required.

4-46. CIRCUIT ANALYSIS. Assuming that the circuit of figure 4-8 is oscillating, a periodically alternating r-f voltage then exists across the interaction grids, and a corresponding periodically reversing field is created. Thus, as electrons from the cathode pass through the interaction space, some are speeded up by the field, while those electrons crossing during the negative alternation of the r-f cycle are slowed down. The electrons then travel toward the highly negative repeller electrode, some with less velocity than others. The high negative potential of the repeller causes the electrons to reverse their direction of travel and proceed back toward the resonator grids. The faster electrons travel further toward the repeller and take a longer time to return to the interaction space. Having originally crossed this space earlier than the slower electrons, the faster electrons return to the space at the same time as the slower electrons. Thus, both groups of electrons, the slow and the fast moving, return in bunches at the interaction grids. These bunches tend to center at those electrons that initially passed through the interaction space when the r-f voltage across it was zero, and decreasing. If the bunched electrons arrive at the interaction space at a time when the r-f voltage between the interaction grids is a positive maximum, they will encounter greater opposition from the field and will give up the maximum possible energy to the tank circuit. This energy replaces tank-circuit losses and sustains oscillations. The time of arrival of the bunched electrons at the interaction space is determined by the magnitude of the repeller voltage. In addition, the optimum time for sustaining oscillations involves an integral number of cycles plus three-quarters of a cycle (such as 1-3/4, 2-3/4, 3-3/4, etc.) between successive crossings of the interaction space by the same electrons.

Thus, if the repeller voltage is maintained at that value which causes the bunched electrons to return to the interaction space in a time equal to 1-3/4, 2-3/4, etc. cycles, and the external cavity has been tuned to the corresponding frequency, the most favorable conditions for oscillation have been satisfied.

4-47. MODE SWITCHING. The frequency of oscillation is determined by the resonant frequency of the cavity and by the magnitude of repeller voltage. For a given setting of the cavity, there is an optimum value of repeller voltage that causes the bunched electrons to return to the resonator grids at the proper time. Therefore, the repeller voltage cannot be kept constant over the frequency range of the oscillator. In order to make the oscillator function over its wide frequency range from 7000 to 10,750 megacycles, an arrangement (figure 4-9) is used to vary the d-c voltage on the repeller so that repeller voltage is maintained at the optimum value for the maximum amplitude of oscillation. However, in the vicinity of 9,500 megacycles, the repeller voltage becomes excessively high so that it is more convenient to change the repeller voltage to a new range. This can be done without changing the frequency of oscillation (at a particular cavity setting) by lowering the repeller voltage so that the tube operates in a higher mode, that is, the bunched electrons require a longer time in cycles to be returned to the resonator grids by the repeller electrode potential. By adjusting repeller electrode voltage to the proper value, the bunched electrons still arrive at the resonator at that time that causes them to yield energy and sustain oscillations. The signal generator employs the 3-3/4 repeller mode over the frequency range from 7,000 to 9,500 megacycles per second. At 9,500 megacycles, it is advantageous to switch to the 4-3/4 repeller mode, which permits oscillation at a lower voltage range.

4-48. REPELLER-VOLTAGE TRACKING CIRCUIT. (See figure 4-9.) The d-c voltage applied to the repeller is controlled by potentiometer R95. The arm of this potentiometer is mechanically ganged with the shorting contacts of the oscillator cavity so that the repeller voltage is maintained at the optimum point for oscillation. Repeller MODE SWITCH S4 is operated by a cam on the main tuning drive and changes the voltage applied to this potentiometer so that a lower range of voltage is used over the frequency range from 9,500 to 10,750 megacycles. The values of resistors in the circuit are selected to insure that the proper frequency-versus-voltage characteristic is obtained for the repeller electrode. R91, R92, R93, R94 and R96 are screwdriver-adjustable potentiometers that set the voltage applied to R95. The maximum excursion of input voltage across R95 varies from minus 1250 volts (fed to the circuit from the beam power supply via pins 2 of connectors J11 and P11) to minus 1700 volts (fed to the circuit from the repeller supply via pins 4 of connectors J11 and P11). Since the cathode of V13 is fixed at minus 1250 volts, the potential difference between the repeller electrode of the tube and the cathode can vary from zero to minus 450 volts.

4-49. CLIPPER DIODE V12. A clipper or protective diode is connected between the cathode of the klystron oscillator and the repeller electrode to prevent the repeller from going positive with respect to the cathode. The cathode (pin 7) of the diode is connected directly to the cathode (pin 3) of the klystron, which is at minus 1250 volts. Since the plates (pins 1 and 6) of the diode are directly connected to the repeller electrode of the klystron, any system disturbance serving to make these plates (or the repeller electrode) more positive than minus 1250 volts will cause V12 to conduct. Since the plate-to-cathode resistance of V12 is less than the external load resistors R97 and R98 when V12 is conducting, most of the voltage drop takes place across R97 and R98 and the potential on the plates of V12 remains at essentially the same minus 1250 volts as its cathode. The repeller electrode of V13 will remain consistently at a minimum absolute potential of minus 1250 volts in the event of any factor that might drive the repeller more positive than the cathode of the oscillator tube.

4-50. ATTENUATOR CIRCUIT. (See figure 7-1.) Microwave r-f power is coupled out of the oscillator cavity by means of a pick-up loop at the end of a 50-ohm coaxial line. The r-f power is then fed through an attenuator AT1, which consists essentially of a cylindrical waveguide that is beyond cutoff for the frequency range of the generator. Input to the waveguide is a 50-ohm coaxial line terminated in the bolometer R101, whose resistance is 50 ohms. This resistor functions both as a launcher of power into the cut-off attenuator and as the r-f monitoring element. R-f energy cannot propagate as a traveling wave in the cut-off attenuator, but is attenuated. The energy density in the cut-off section tends to decay exponentially with distance, giving an almost linear characteristic in decibels. Power is coupled by means of a movable 50-ohm coaxial line. By varying the distance of the output coupling element R102 from the launching element R101 the level of r-f output at the front panel jack J13 is correspondingly changed. As the OUTPUT ATTENUATOR control is turned clockwise, a friction disk, on which the calibrated attenuator dial is mounted, is actuated. Rotation of the pinion at the center of the friction disk drives a rack, which separates the output coupling element R102 a greater distance from the power launching element R101. The r-f output level in DBM is obtained by reading the value of the curve which appears directly under the crossed hairlines on the attenuator-dial window. The dial window assembly is mechanically linked to the SIGNAL FREQUENCY drive so that automatic correction is made for the frequency dependence of the attenuator.

4-51. R-F MONITOR CIRCUIT. (See figure 4-10.)

4-52. The r-f monitor is provided to insure that the output-level indicating dial correctly gives the power level available at RF OUTPUT jack J13. The monitor employs a self-balancing Wheatstone bridge. One of the arms is the bolometer R101. A two-stage, tuned, audio-frequency amplifier V38 and V39, operating at 10 kilocycles per second, impresses its output across one set of terminals of the bridge. The resulting voltages developed across alternate terminals are fed back to the amplifier input in proper phase to produce a-f oscillations. The a-f power thus generated quickly changes bolometer resistance and brings the bridge into near

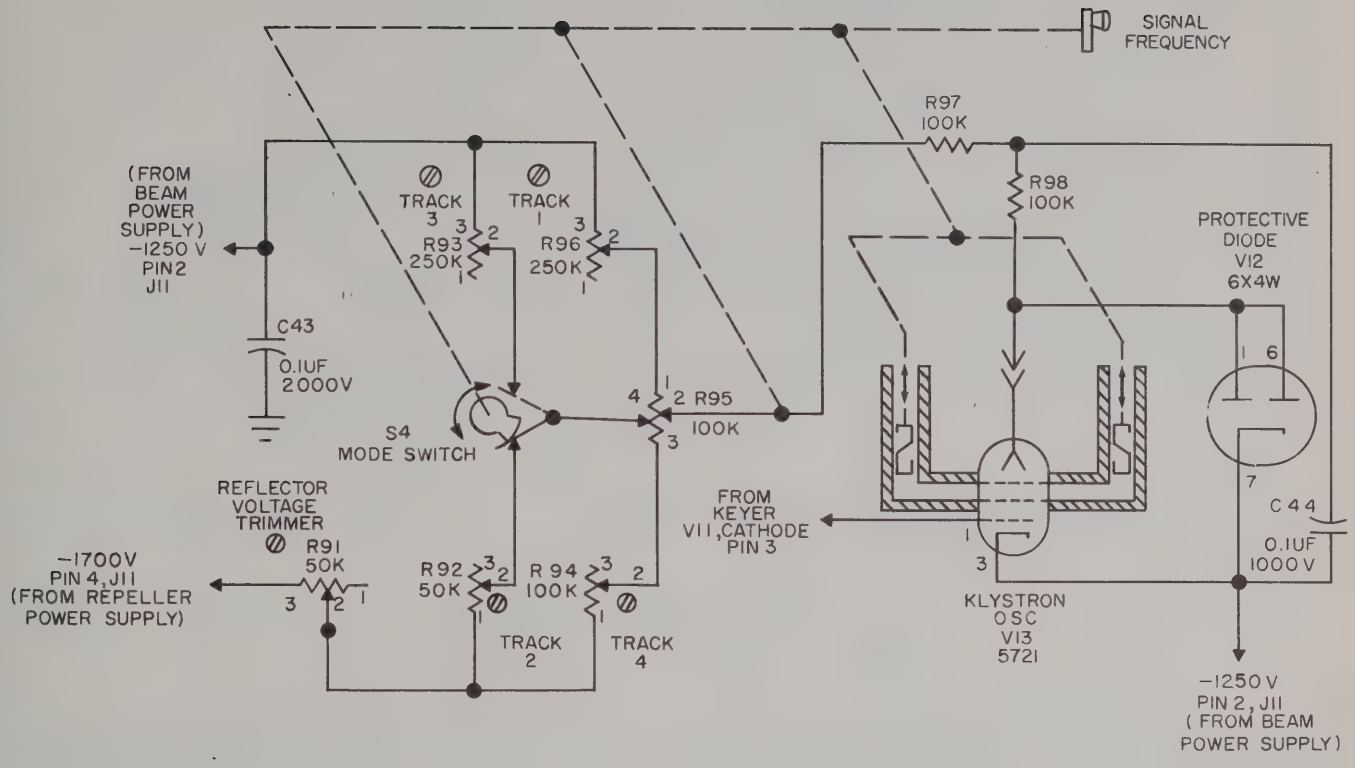


Figure 4-9. Repeller Tracking Circuit and Klystron Oscillator, Simplified Schematic

balance. Should r-f power be applied to the bolometer element, an equivalent amount of audio power is automatically withdrawn by the a-f amplifier in order to preserve the balanced condition of the bridge. An a-c voltmeter (calibrated in db) across the output of the audio amplifier serves to indicate a-f power level, if the bridge resistance is known.

4-53. POWER-SET METER RANGE. The r-f monitor circuit is designed so that when the output reference level meter reads ZERO SET (extreme left-hand index on meter scale), the level of a-f power in bolometer element is 26.67 milliwatts. When the meter pointer deflects to plus 3 db position (extreme right-hand index on meter scale), a-f power in the bolometer element is 6.67 milliwatts. Accordingly, the meter scale covers a-f power range from 6.67 milliwatts to 26.67 milliwatts, or a total range of 20 milliwatts. An increase in a-f power is indicated by a left-hand deflection of the meter pointer, while a decrease in a-f power is indicated by a right-hand deflection. If the meter is initially brought to balance by a-f power alone, the meter pointer will deflect to the right when r-f power is added to the bolometer element since an exactly equal amount of a-f power is automatically withdrawn. Meter scale is graduated so that an r-f level of 10 milliwatts (corresponding to an a-f level of 16.67 milliwatts) is indicated by zero DB, with corresponding graduations for other r-f levels between zero and 20 milliwatts. The reference r-f power level of 10 milliwatts is set by the POWER SET control, which lowers or raises the pick-up loop in the oscillator cavity.

4-54. R-F MONITOR CIRCUIT. (See figure 4-11.) The r-f monitor circuit consists of a two-stage, tuned, a-f amplifier employing feedback, a Wheatstone-type bolometer bridge, and a peak-reading a-c voltmeter. The amplifier is tuned to 10 kilocycles by C85 and L7 that form a parallel-resonant circuit of high Q in the plate of V38. Any audio voltage developed at the plate (pin 5) of V38 is coupled by C87 to the grid (pin 1) of power amplifier V39. The amplified a-f voltage appearing at the plate (pin 5) of V39 is coupled to the input of the bolometer bridge by a-f transformer T10. Bridge output from the junction of R205 and the series-parallel network is fed back to the input of the amplifier by connecting this junction point to the control grid of V38. The supply voltage to the screen grids (pins 6) of V38 and V39 is dropped by means of the R202. Resistor R200, connected from the screen grid of V38 to the screen grid of V39, is a parasitic suppressor. R201 is a biasing resistor in the cathode circuit of V38. C88 functions as an audio-frequency bypass for R204. R203 is the grid-leak resistor for V39. If the resistance in the adjustable arm of the bridge is initially greater than the bolometer resistance, the bridge will be unbalanced. An a-f voltage will then exist across the output terminals of the bridge in such phase as to increase the output of the a-f amplifier. This condition increases a-f power in the bolometer and raises its resistance

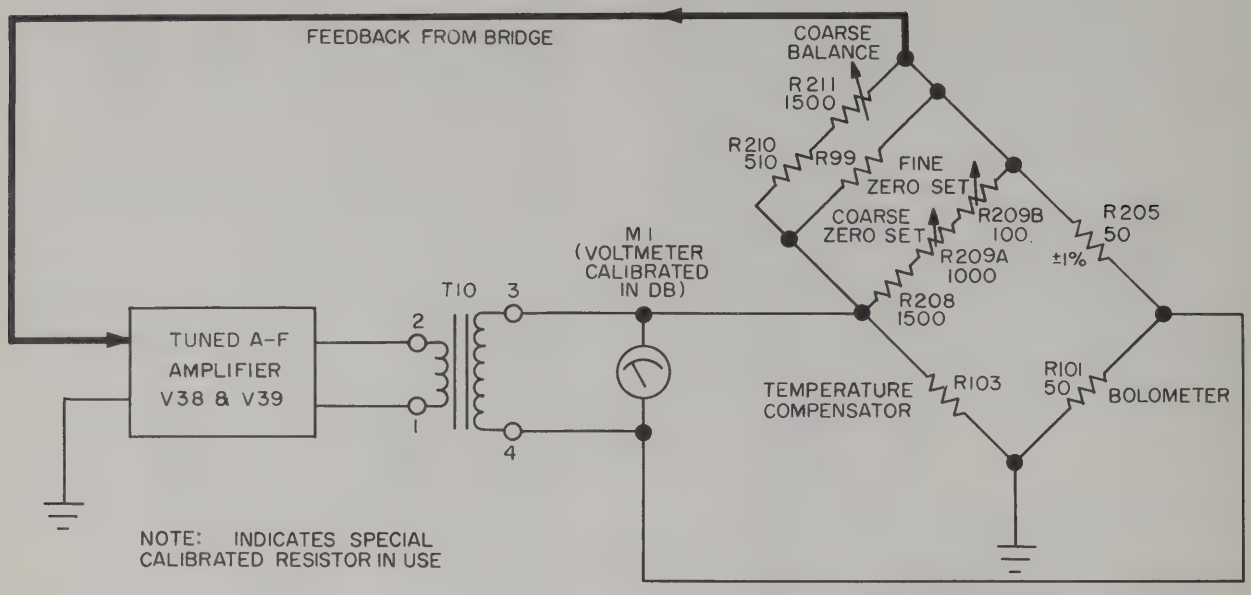


Figure 4-10. R-F Monitor, Block Diagram

value. (The bolometer consists of a metallic film deposit on a pyrex rod, the resistance of which increases with a rise in temperature.) The bridge will, therefore, rapidly approach balance, and the amplifier will reach a stable operating condition. If r-f power is added to the bolometer, an equivalent amount of a-f power will be withdrawn by the amplifier in order to restore the bridge to its original balanced condition. By adjusting COARSE control R209A and FINE control R209B, it is possible to set a-f power level so that a certain amount of a-f power is dissipated in the bolometer arm when no r-f power is applied.

4-55. POWER-SET METER CIRCUIT. (See figure 4-11.) The peak-reading a-c voltmeter includes a series combination of capacitor C90 and crystal diode CR9 connected across the secondary winding of transformer T10. The crystal diode is shunted by the series network of R206 and meter M1. If the shunting network across diode CR9 were absent, C90 could charge up to the peak a-f voltage when terminal 4 of transformer T10 is swinging positive (via the conducting crystal), and would be unable to discharge as the voltage at terminal 4 of T10 begins to decrease. It would ,therefore, remain charged to the peak a-f voltage. C91 is connected across the meter terminals. With METER SELECTOR switch S6 in POWER MONITOR position, the shunting network is connected across diode CR9. It is, therefore, possible for C90 to discharge through the network. Because of the long time-constant of the network, however, C90 remains charged nearly to the peak a-f voltage. C91 is utilized to obtain a peak meter reading during the entire a-c cycle. R206 is set during calibration so that meter M1 deflects to the left-hand index of the scale, marked ZERO SET, when 26.67 milliwatts of a-f power are dissipated in bolometer R101. This meter has a reverse-reading 200-microampere movement with 100 microamperes suppressed, that is, the meter pointer deflects full scale to the left for 200 microamperes, and rests at the extreme right-hand index of the scale for 100 microamperes. With zero current, the meter pointer will be off-scale and in its most extreme right-hand position. The scale is marked in DB and indicates r-f power correctly when the circuit has been adjusted so that, with zero r-f power and 26.67 milliwatts of a-f power in the bolometer, the pointer deflects to the zero db red-line calibration; and if 20 milliwatts of r-f power is added, the pointer deflects to the plus 3 db position. Since the reference level is 10 milliwatts, r-f power levels less than 10 milliwatts will be indicated by negative db deflection to the left of the zero db mark. Meter M1 also serves as d-c milliammeter for reading beam current of the reflex klystron tube. When METER SELECTOR S6 is placed in its BEAM CURRENT position, the negative terminal of the meter is grounded while the positive terminal is connected to resistor R159.

4-56. POWER SUPPLIES.

4-57. FILAMENT SUPPLY. (See figure 4-12.) The filament supply, POWER ON pilot lamp I-2, blower B1, repeller power supply, keyer supply, and plus 250-volt power supply are energized immediately when POWER switch S5 is thrown ON and power plug P401 is connected to a proper voltage source. The heater in DELAY RELAY K1 goes on at the same time as the filament supply, causing K1 to close about one minute later. The closing of K1 energizes the beam supply. Input power transformer T6 for beam supply is connected to input power through HOLD RELAY K2 and can only become energized when K2 is energized. (See figure 7-1.) Terminal 1 of the primary of T6 connects directly back to one end of input power. The other end of T6 primary, terminal 2, connects to contact 4 of K2, which is open-circuited when K2 is not energized.

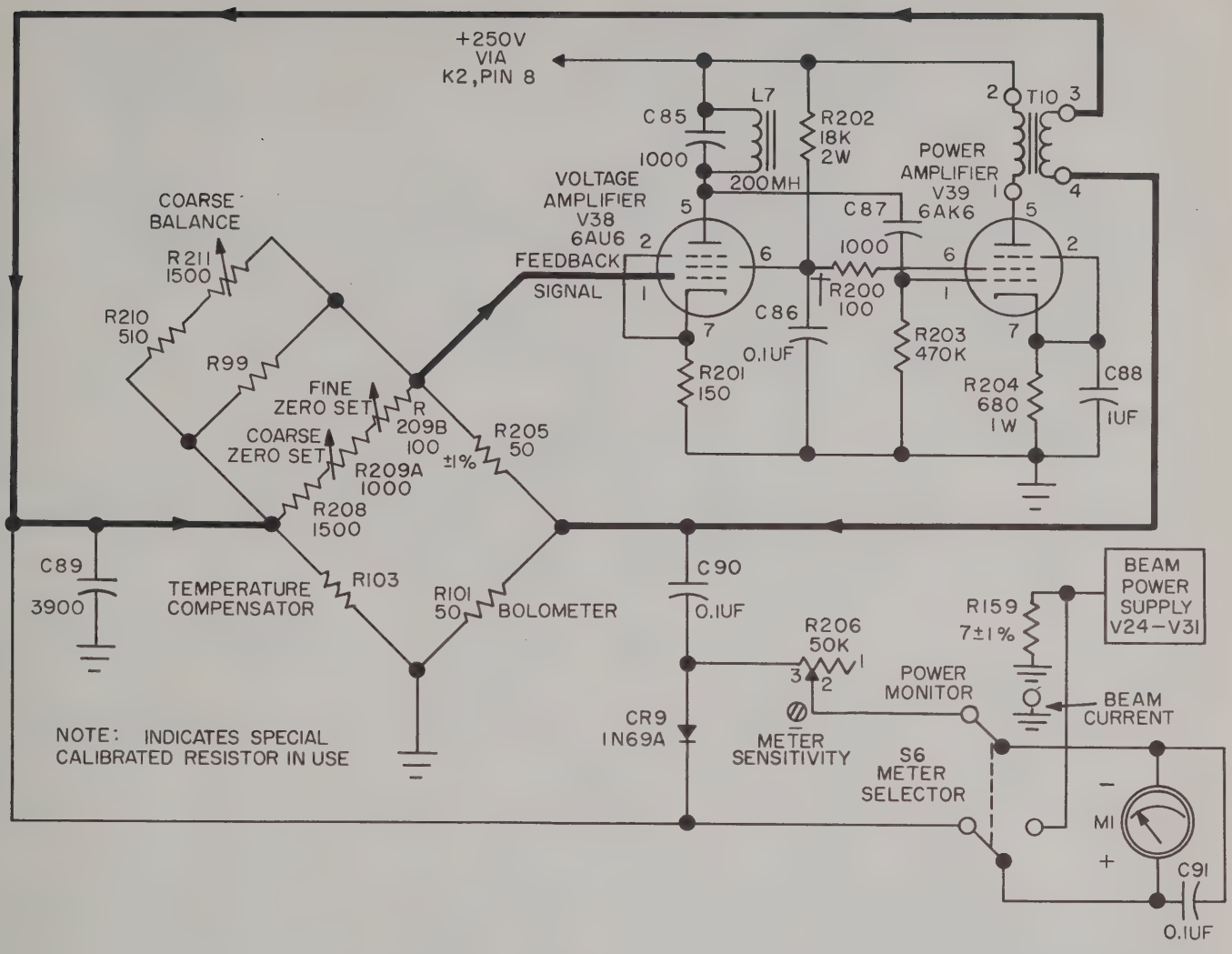


Figure 4-11. R-F Monitor, Simplified Schematic

When S5 is thrown to ON, the heater of K1 is energized. As soon as the heater of K1 causes K1 to close, the hold coil (between contacts 10 and 1) of K2 is energized.

4-58. Input power is fed directly to the primary of T6 to activate the beam power supply. The potential for the plates of the tubes in the modulator section and for V38 and V39 is not available until the beam power supply is activated (K2 is energized). When S5 is in the OFF position and P401 is connected to a proper voltage source, HEATER pilot I1 and space heaters HR1 and HR2 are energized while all other circuits are off. To de-energize all circuits of the instrument, P401 must be disconnected.

4-59. 250-VOLT SUPPLY. (See figure 7-1.)

4-60. The 250-volt supply consists of a full-wave rectifier V34 and a voltage-regulating circuit, V35 through V37. The rectifier filament is tied to a pi-type filter, shunted by the load. The regulator produces an output voltage independent of fluctuations in the a-c supply and changes in load over a wide range. The regulated output voltage of 250 volts is developed across capacitor C84. V35 cathode (pin 7) is at ground potential. The potential of V35 grid (pin 1) is determined by the setting of potentiometer R192. The grid voltage operates at a magnitude, with respect to the cathode, to produce a flow of plate current through load resistor R185 sufficient to maintain the desired 250-volt output. If the load voltage tends to increase, that is, the output becomes more positive than 250 volts, the voltage on the grid of V35 tends to rise while the cathode voltage remains constant. V35 then conducts more heavily, resulting in a larger voltage drop across plate load R185. Since the plate of V35 (pin 5) is directly connected to the grids of V37 (pins 4 and 1), plate resistance of V37 increases, its control grids being driven more negative. A larger portion of the available voltage appears across the higher resistance of V37 and the load voltage remains constant. Since V37 is series-connected to the output, the increased voltage drop across its electrodes causes a corresponding decrease of voltage across the output, thus compensating for the original increase in potential. The action is reversed if the load voltage

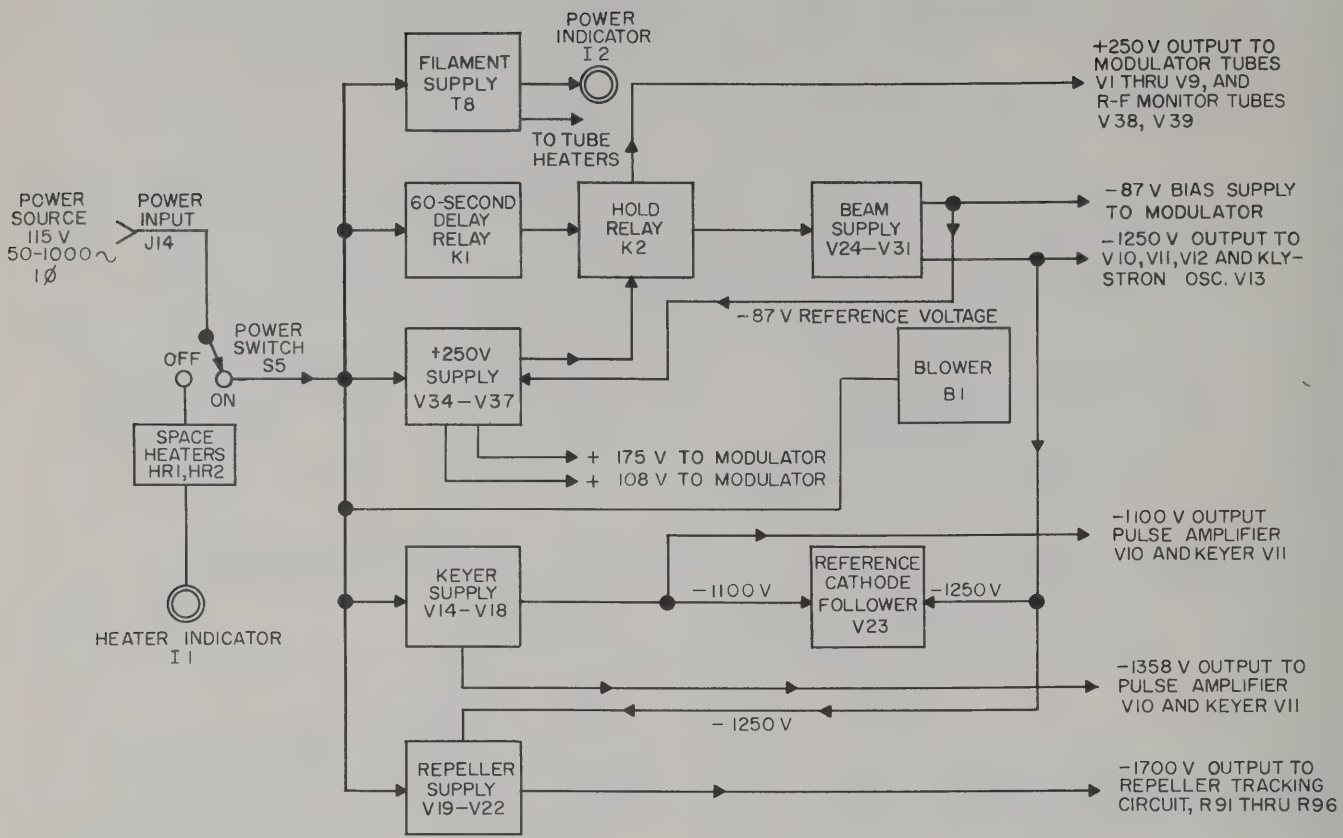

POWER INDICATOR I2
FILAMENT SUPPLY T8
TO TUBE HEATERS
+250 V OUTPUT TO MODULATOR TUBES V1 THRU V9, AND R-F MONITOR TUBES V38, V39
POWER SOURCE 115 V 50-1000~ 1Ø
POWER INPUT J14
60-SECOND DELAY RELAY K1
HOLD RELAY K2
BEAM SUPPLY V24–V31
-87 V BIAS SUPPLY TO MODULATOR
-1250 V OUTPUT TO V10, V11, V12 AND KLYSTRON OSC. V13
-87 V REFERENCE VOLTAGE
POWER SWITCH S5
OFF
ON
+250V SUPPLY V34–V37
BLOWER B1
SPACE HEATERS HR1, HR2
+ 175 V TO MODULATOR
+ 108 V TO MODULATOR
-1100 V OUTPUT PULSE AMPLIFIER V10 AND KEYER V11
KEYER SUPPLY V14–V18
-1100 V
REFERENCE CATHODE FOLLOWER V23
-1250 V
HEATER INDICATOR I1
-1358 V OUTPUT TO PULSE AMPLIFIER V10 AND KEYER V11
- 1250 V
REPELLER SUPPLY V19–V22
-1700 V OUTPUT TO REPELLER TRACKING CIRCUIT, R91 THRU R96

Figure 4-12. Power Supply, Block Diagram

tends to fall. Capacitors C83 and C84 act as by-pass capacitors which minimize ripple and offer a low impedance path to any a-c current components that circulate through the power supply. Cathode resistors R194 and R195 function to balance the current in each section of V37. Voltage reference tube V36 is connected to the screen grid (pin 6) of V37, which is at the reference voltage of 108 volts.

4-61. Biases are provided by connecting the series of voltage-dropping resistors R186 through R190 to the plus 250-volt supply line. At the junction of resistors R188 and R189, a positive potential of 175 volts is tapped, and is fed via pins 10 of connectors P2 and J2 to the modulator. From the plate (pin 5) of V36, the positive 108-volt reference voltage is fed via pins 9 of connectors P2 and J2 for use in the modulator circuit.

4-62. BEAM POWER SUPPLY. (See figure 4-13.)

4-63. The beam power supply provides the voltage and current to the interaction grids of reflex klystron V13 to maintain them at a high positive potential with respect to the cathode. Since the interaction grids make contact with the klystron-oscillator cavity, it is safer to ground the positive side of the power supply through R159, while the negative side is connected to the cathode of V13 (pin 3) through pin 2 of connector P11. The beam power supply also furnishes negative 87 volts to pin 4 of connector P2 for biasing purposes in the modulator section.

4-64. The repeller power supply, V19 to V23, and the keyer supply V14 to V18, are referenced to the beam supply. This is accomplished by directly connecting the negative 1250-volt output from the beam supply to the positive side of the repeller output load. The beam supply output of negative 1250 volts is also connected to the negative side of the keyer system (through R177 through R180) via the cathode (pin 7) of V18, and to the cathode of V23, the cathode-follower stage of the keyer circuit. Thus, while the output voltage from the repeller supply has a variation of 450 volts, the absolute potential varies from negative 1250 volts to negative 1700 volts with respect to ground. Similarly, although the keyer output is 258 volts, the output varies from negative 1100 volts to negative 1358 volts.

4-65. The beam power supply consists of a voltage doubler and an electronic regulator. The voltage doubler includes V24 and V25. Capacitors C67 and C66 are charged on alternate half-cycles and are so connected that the voltages add in the output. This circuit is capable of delivering an output voltage that is approximately twice the peak voltage of the applied alternating potential. When terminal 3 on T6 secondary is more positive than terminal 4, a voltage is impressed across V24 in series with capacitor C66. Since the plates of V24 (pins 4 and 6) are then more positive than their cathode, current flows in the V24 circuit. The source of electrons must be capacitor C66. The upper plate of C66 becomes positive relative to the

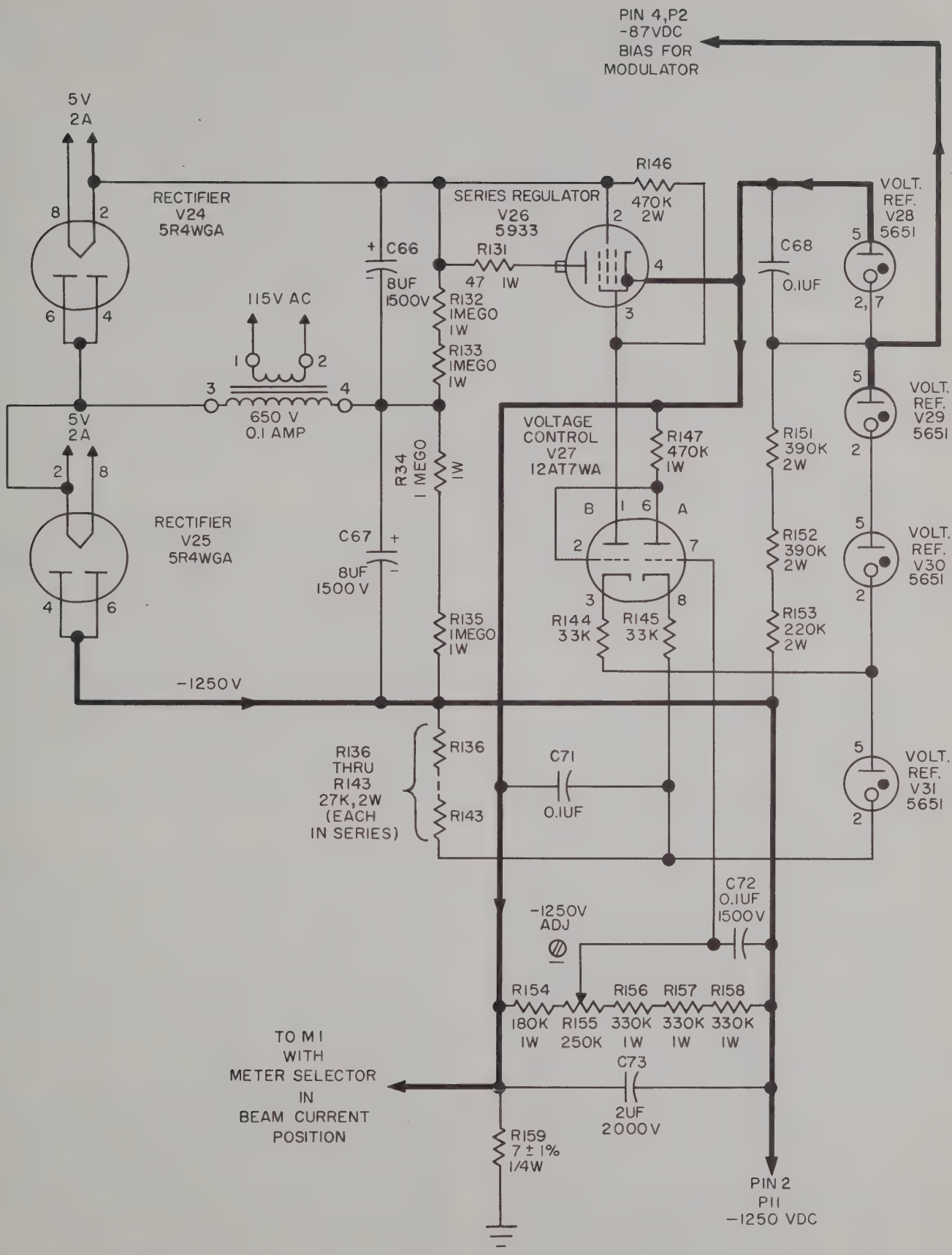


Figure 4-13. Beam Power Supply, Simplified Schematic

lower plate by a voltage slightly less than the peak voltage of the input sine wave. Since V24 will maintain some finite voltage drop across its electrodes during conduction, the capacitor does not quite charge to the peak voltage of the input signal. During the alternate half-cycle, since V24 does not conduct, C66 discharges slightly by allowing a small current to flow from the upper plate of C66 through R132 and R133 to the lower plate. While C66 is discharging in this manner, C67 charges through V25. The output voltage across R132, R133, R134 and R135 is equal to the sum of the voltages across C66 and C67, which is approximately twice the peak voltage developed across the transformer secondary. As a safety measure, the resistors allow the charge on C67 and C68 to leak off when the transformer is not energized.

4-66. The electronic voltage regulator consists of the series regulator tube V26, the voltage control tube V27, and gaseous VR tubes V28, V29, V30, and V31 in series, together with associated resistors and capacitors. Output voltage is developed across bleeder resistors R154, R155, R156, R157 and R158. These resistors make up one part of a voltage divider. All other circuit elements are used to control the resistance of tube V26 and to maintain a constant voltage across the load. The cathode (pin 3) of V27 is maintained at a fixed potential by being directly connected to V31, one of the voltage-reference tubes. This serves to keep the cathode potential fixed and independent of any output-voltage variation. Similarly, the cathode (pin 8) of V27 is returned to the junction between the cascaded series of the four gas tubes and the group of voltage-dropping resistors R136 to R143.

4-67. The grid (pin 7) of V27 operates at a voltage selected by R155. This potentiometer is set so that the grid voltage operates at a value with respect to the cathode to produce a flow of plate current through load resistor R146 that maintains the desired negative 1250-volt output. If the load voltage tends to increase (become more negative than 1250 volts), the voltage on the grid (pin 7) of V27 tends to rise (become more negative), while the cathode voltage remains practically constant. The tube then conducts less current, raising the plate potential. Since the plate (pin 6) is directly coupled to the grid (pin 2) of V27, this grid potential also rises. This causes V27B to conduct more strongly and its plate voltage falls. This voltage (the bias for V26) causes the plate resistance of V26 to increase. A larger portion of the available voltage appears across the higher resistance of V26, and the load voltage remains practically constant. Since V26 is series connected to the output, the increased voltage drop across V26 thus compensates for the original increase of potential. Action is reversed if the load voltage tends to fall.

4-68. KEYER POWER SUPPLY. (See figure 4-14.)

4-69. The keyer power supply controls the potential of the control grid (pin 1) of V13. Specifically it supplies negative 1358 volts to the cathode circuits of V10 and V11, the pulse amplifier and keyer, and negative 1100 volts to the plate circuit of the V11. This is accomplished by directly connecting negative 1358 volts from the keyer power supply through pin 3 of plug P11 to the cathode circuit of V11, and by feeding negative 1100 volts to the plate circuit of V11 via pin 1 of plug P11. The output of the keyer is a voltage extracted across R82, the cathode resistor of V11. This voltage is fed directly to the control grid of the klystron.

4-70. The keyer power supply consists of a full-wave rectifier V14 and a voltage regulator. The rectifier cathode (pin 7) is tied to load resistor R113. The other end of R113 is connected to the center tap of T5 secondary (terminal 4). Capacitor C56 is the filter. During one of the alternations, the upper diode plate (pin 1) is positive relative to the cathode (pin 7). Therefore, current flows in one-half of the diode. This current causes a voltage drop across R113 such that the terminal joined to C56 is more negative than the terminal joined to V14 cathode (pin 7). During the same half cycle, the voltage across terminals 4 and 5 of the transformer secondary makes the lower plate (pin 6) negative relative to its cathode, thus causing this tube to remain non-conducting. A half cycle later, the voltages on the plates of the tube are reversed. The lower diode now conducts, while the upper tube is cut off. Thus, a full-wave pulsating d-c is produced across the load resistor.

4-71. The voltage-regulator section consists of V15 and V16 in parallel (functioning as series regulator tubes), voltage control V17, voltage reference V18, and cathode follower V23. The regulator produces an output voltage that is independent of fluctuations in the a-c supply and any changes in load. Output voltage is developed across bleeder resistors R114, R115, and R116, part of a voltage divider. All other circuit elements, except for the cathode follower, control the resistance of tubes V15 and V16 to maintain a constant voltage across the load. The cathode (pin 7) of V17 is connected to the plate (pin 1) of V18. The cathode (pin 7) of V18, is tied to negative 1358 volts, a fixed reference potential. Capacitors C58 and C59 act as by-pass capacitors which minimize ripple and offer a low impedance path to any a-c current components.

4-72. The grid (pin 1) of V17 operates at a voltage selected by potentiometer R115. If the load voltage (negative 1100 volts) tends to increase, the grid of V17 becomes more positive. Since the cathode level of V17 remains constant, control tube V17 will conduct more strongly and its plate voltage falls. This voltage, the bias for V15 and V16, causes the plate resistance of V15 and V16 to increase. A greater portion of the available voltage appears across the increased resistance of V15 and V16, and the load voltage remains constant.

4-73. Cathode follower V23 references the keyer voltage supply with respect to the beam supply. The tube consists of two triodes in parallel. The output voltage of negative 1250 volts from the beam supply is connected directly to the cathodes (pins 3 and 8) of V23. The cathodes are also series-connected to the negative output of the keyer power supply through a series-parallel combination of resistors R177 through R180. The plates (pins 1 and 6) of V23 are connected to the positive output of the supply which is a potential of negative 1100 volts. In addition, there is a direct connection between the plate (pin 1) of V18 and the control

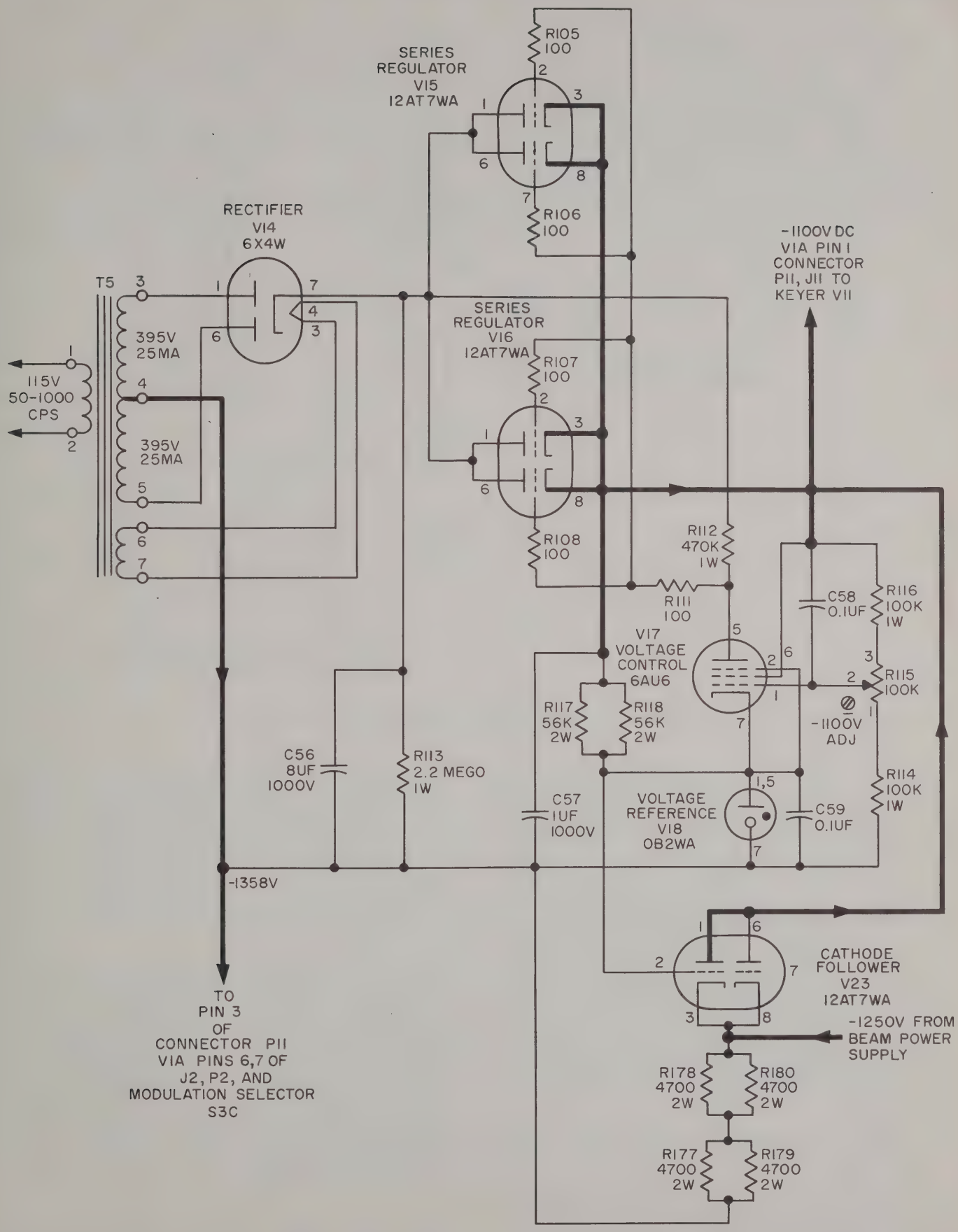


Figure 4-14. Keyer Power Supply, Simplified Schematic

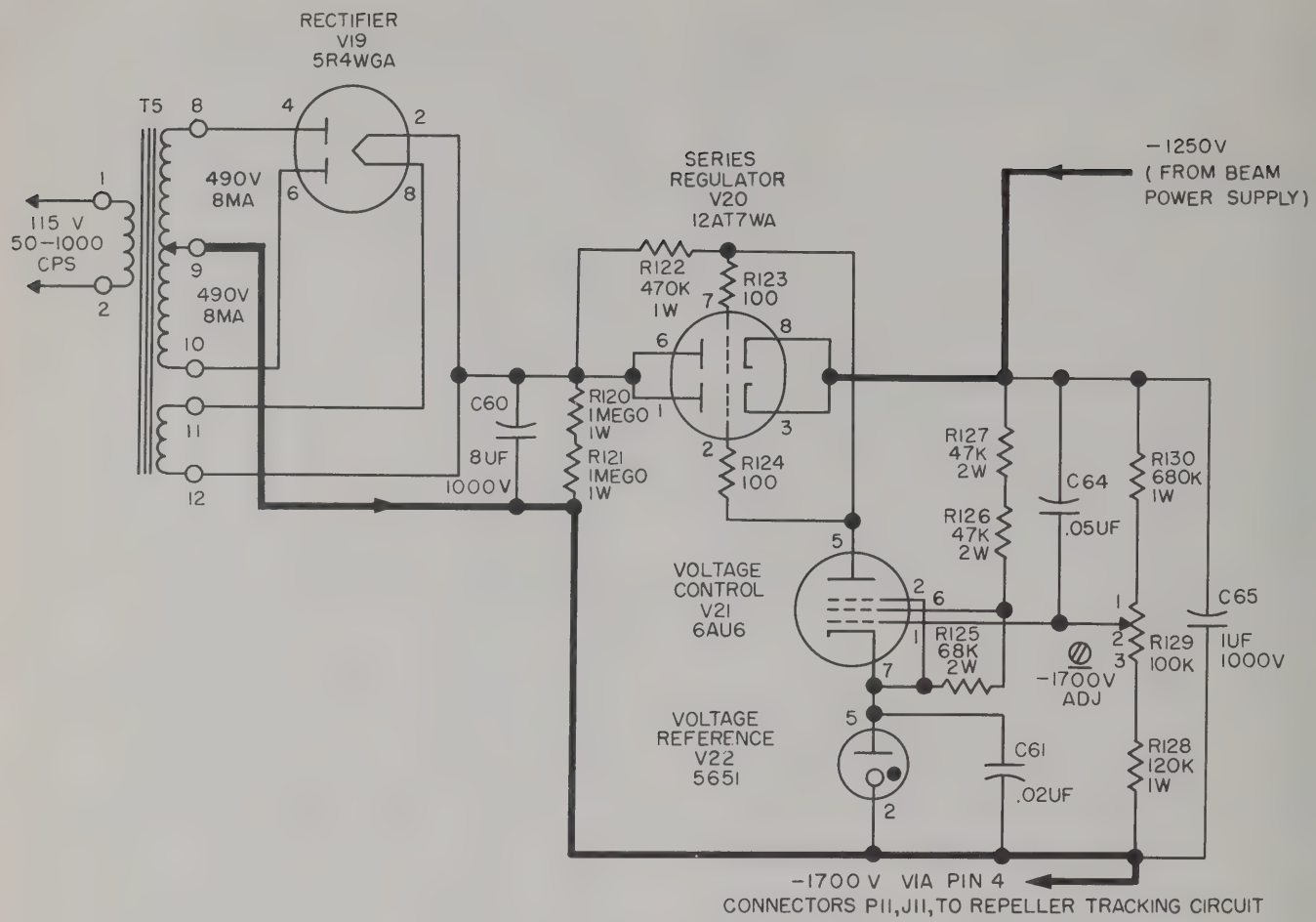


Figure 4-15. Repeller Power Supply, Simplified Schematic

grids (pins 2 and 7) of V23. Since the plate of V18 is at a positive potential with respect to its cathode, the control grids of V23 operate at a positive potential with respect to their cathodes. This forms a low impedance path between the grids and cathodes. With negative 1250 volts directly connected to the cathodes of V23, the plate of V18 is then fixed at this same potential. Since the cathode of V18 is negative with respect to the plate by approximately 108 volts (drop across the VR tube), the cathode assumes an absolute potential of negative 1358 volts with respect to ground. In addition, the positive terminal of the keyer supply (which is 258 volts above the cathode potential of V18), provides a potential of negative 1100 volts. Thus, the cathode follower offers a method of providing both more positive (negative 1100 volts) and more negative (negative 1358 volts) voltages with respect to the cathode of klystron V13 (negative 1250 volts).

4-74. REPELLER POWER SUPPLY. (See figure 4-15.)

4-75. The repeller electrode of V13 must be kept at a negative potential with respect to its cathode. This negative voltage is furnished by the repeller power supply. Since it is necessary to reference the repeller power supply to the beam power circuit, the regulated output of negative 1250 volts from the beam supply is directly connected to the positive side of the repeller output load. Thus, though the total output variation from this circuit is 450 volts, the absolute potential varies from negative 1250 volts to negative 1700 volts. The negative side of the repeller supply (negative 1700 volts) is connected through pin 4 of connectors P11 and J11 to the repeller tracking circuit.

4-76. The repeller power supply consists of a full-wave rectifier V19 and a voltage regulator. The rectifier filament is tied to filter capacitor C60. A full-wave pulsating d-c current is produced across the load. This voltage is applied across filter capacitor C60. Since the rate of charging C60 is limited only by the reactance of the transformer secondary and the plate resistance of the rectifier tubes, the voltage across the capacitor can rise nearly as fast as the voltage output from the rectifier. When the rectifier output starts to drop, the voltage across the capacitor is discharged through the load.

4-77. The voltage regulator consists of series regulator tube V20, voltage control tube V21, and gaseous VR tube V22, together with associated resistors and

capacitors. The regulator produces an output voltage that is independent of fluctuations in the a-c supply and changes in load. The output voltage is developed across bleeder resistors R128, R129 and R130. These resistors make up one part of a voltage divider. All other circuit elements are used to control the resistance of tube V20, and function to maintain a constant voltage across the load. The cathode of V21 (pin 7) is directly connected to the plate (pin 5) of V22. The cathode of V22 is tied to the output, which is negative 1700 volts. Capacitors C61, C64 and C65 act as by-pass capacitors that minimize ripple and offer a low impedance path to a-c currents.

4-78. V21 grid (pin 1) operates at a voltage selected by the -1700 V ADJ potentiometer R129. If the load voltage tends to increase, voltage on the grid becomes more positive with respect to its cathode. This causes the control tube to conduct more strongly and its plate voltage falls. This voltage (the bias for V20) causes the plate resistance of V20 to increase. A larger portion of the available voltage appears across the higher resistance of V20, and the load voltage remains practically constant. Since V20 is series-connected to the output bleeder, the increased voltage drop across V20 causes a corresponding decrease of output voltage. The action is reversed if load voltage tends to fall.

SECTION V

ORGANIZATIONAL MAINTENANCE

5-1. GENERAL.

5-2. Signal Generator TS-622/U is a calibrated test instrument designed for testing the operation of radio and radar equipment. Adjustment and recalibration of the signal generator must be performed only by qualified field and depot maintenance personnel, as outlined in Section VI of this handbook and in the Handbook of Overhaul Instructions for the Radio Test Set AN/URM-44.

5-3. Organizational maintenance personnel are limited primarily to the replacement of tubes, fuses, and lamps.

5-4. MINIMUM PERFORMANCE STANDARDS.

5-5. Refer to table III for a complete technical summary of the signal generator. If any of the operating characteristics listed therein are not attained, attempt to correct by replacing the tube in the section or stage suspected of causing the deficiency. If the malfunction is not corrected, refer to field or depot maintenance personnel.

5-5. INSPECTION.

5-6. Inspect the signal generator visually for mechanical defects such as broken or stuck front-panel controls and dials. Make certain all controls operate smoothly, without binding. Note whether indicating and dial lights operate as required.

5-7. FUSE REPLACEMENT.

5-8. The two active fuses F1 and F2 and the two spare fuses F3 and F4 are located on the front panel (figure 1-2). Use the spare fuses as replacements for the active fuses. Obtain a new fuse as soon as possible.

5-9. TUBE REPLACEMENT.

5-10. All tubes except the klystron oscillator V13, type 5721, can be replaced by organizational mainte-

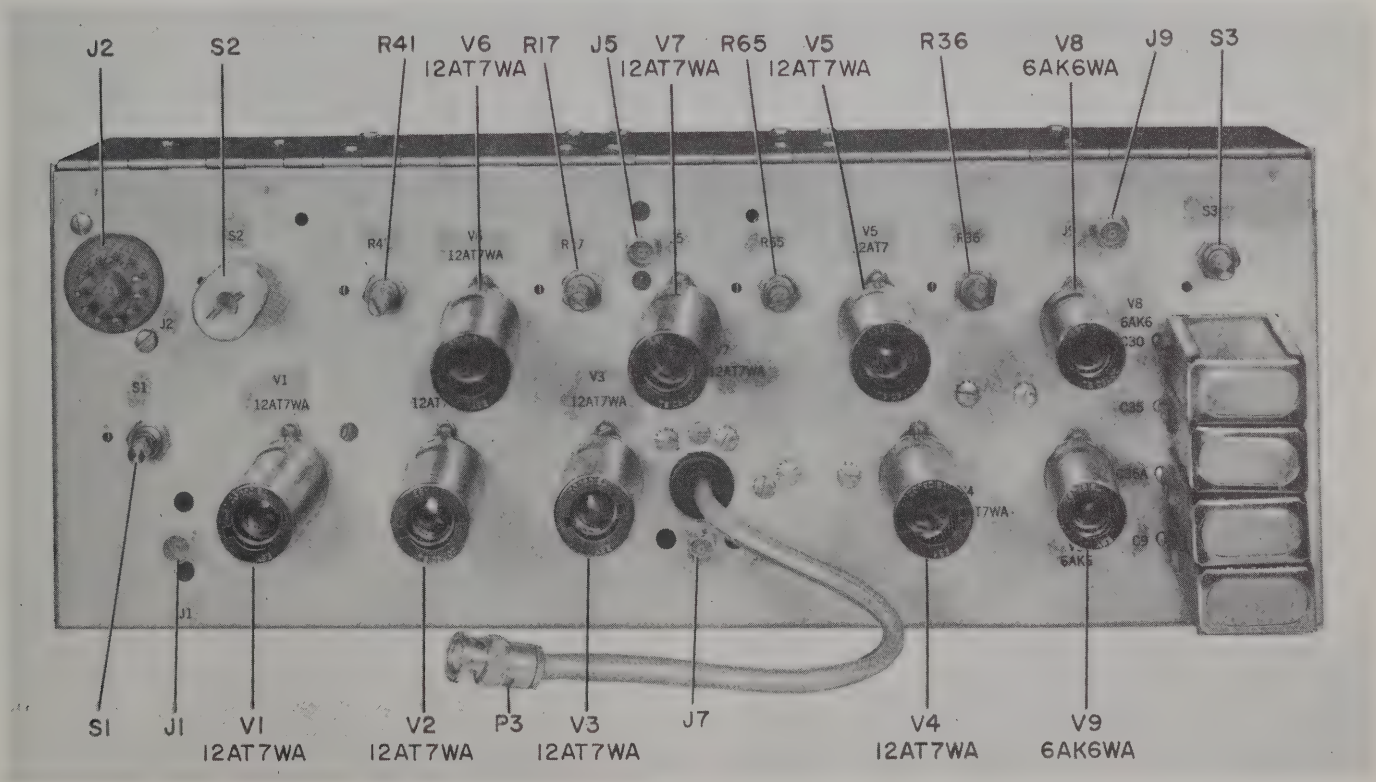


Figure 5-1. Modulator-Chassis Tube Locations

nance personnel. Refer to figures 5-1 through 5-3 for locations of the tubes in the signal generator.

WARNING

High voltages are present in this equipment. Turn power off and remove power input plug from J14 before making any repairs or replacing tubes or lamps. Always discharge circuits by grounding before touching them.

5-11. LAMP REPLACEMENT.

5-12. Dial lamps I3 and I4 (figure 5-4) on the main chassis are made accessible for replacement by removing the screw, washer, and lock washer that secure each lampholder to its mounting bracket.

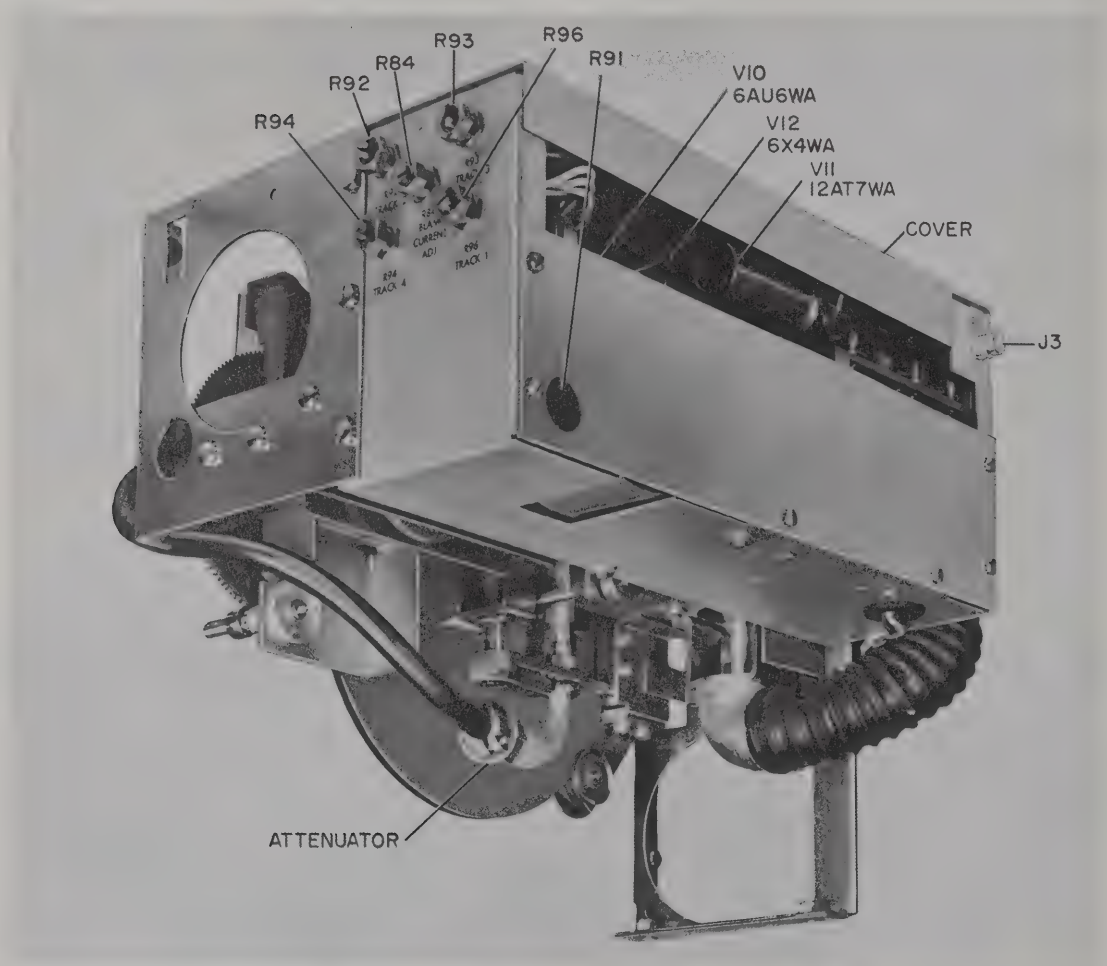


Figure 5-2. Keyer-Chassis Tube Locations

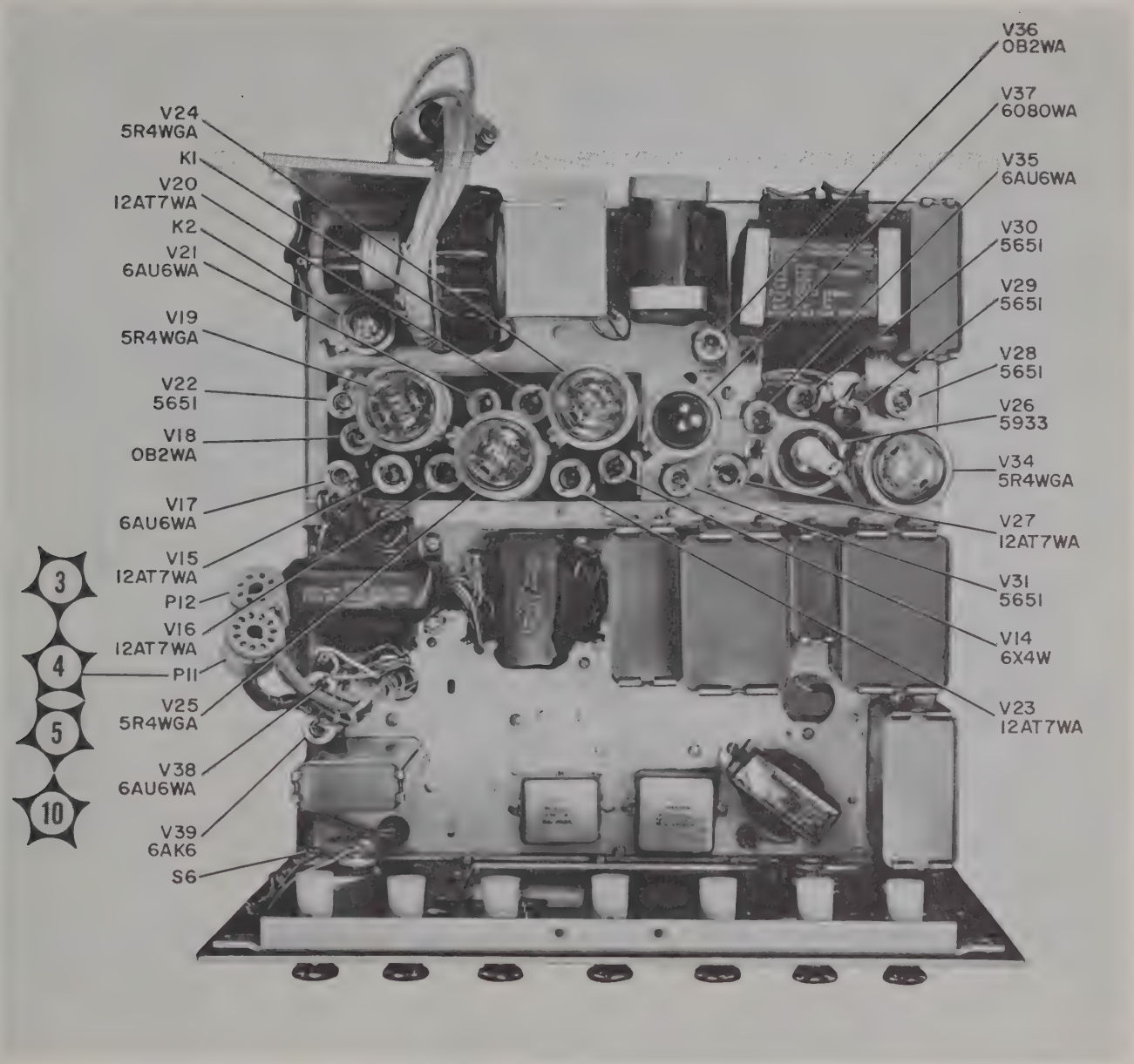


Figure 5-3. Main-Chassis Tube Locations

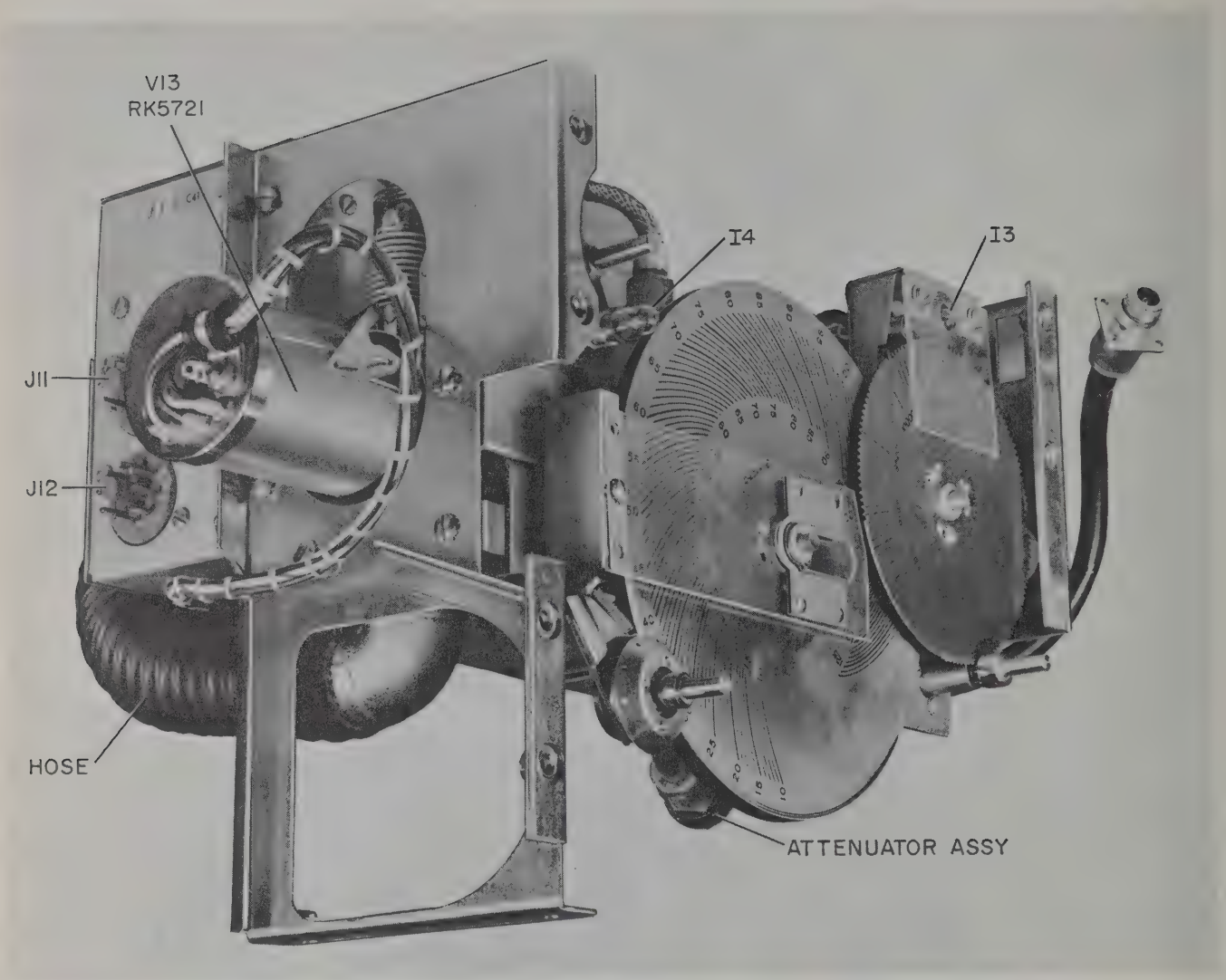


Figure 5-4. R-F Box Dial-Lamp Locations

SECTION VI

FIELD MAINTENANCE

6-1. GENERAL.

6-2. Field maintenance personnel are authorized to troubleshoot the signal generator, and adjust or repair as outlined in this section. Any other services, repairs or adjustments will be referred to depot maintenance personnel.

6-3. MINIMUM PERFORMANCE STANDARDS.

6-4. A conclusive means of checking performance of the Signal Generator TS-622/U is to compare its output in all possible operating modes (table III) against at least two other signal generators of the same model known to be operating satisfactorily. If output and performance do not agree, troubleshoot and repair or calibrate, as outlined in this section. If performance is still not satisfactory, refer to depot maintenance personnel.

6-5. TROUBLESHOOTING.

6-6. Proceed as outlined in table VII below to isolate the trouble. The table is arranged by troubles, probable causes, and remedies and is organized to localize the fault to a particular section of the signal generator. Refer to the schematic diagram (figure 7-1) and to the illustrations in this section for signal tracing and location of components. If a trouble localized to a stage is not corrected by replacement of the tube in that stage, check voltages and resistances in the stage to determine the defective component. Replace as necessary. Use table VIII, test-point analysis, for further testing.

TABLE VII. TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
No output. HEATER and POWER lights off.	No a-c power.	Check a-c power source. Connect power cable.
	Blown fuse.	Replace F1 and/or F2.
HEATER light I1 does not light with POWER switch OFF.	Defective lamp.	Replace I1. If lamp blows immediately, replace R104.
	Defective heater resistors.	Replace HR1 and/or HR2.
Signal generator does not synchronize with sync signal from external equipment applied to SYNC IN jack J4.	SYNC SELECTOR not set properly.	Turn SYNC SELECTOR to SIN, "-", or "+" position to correspond with type and polarity of external sync signal.
	Defective sync amplifier/discriminator V1 or voltage discriminator/trigger amplifier V2.	Replace V1 and/or V2 (para. 5-8).
No undelayed sync pulse; satisfactory delayed sync pulse and r-f output pulse.	Defective undelayed sync blocking oscillator V7.	Replace V7 (para. 5-8).
No delayed sync pulse or r-f output pulse; satisfactory undelayed pulse.	Defective delayed sync blocking oscillator V4.	Replace V4 (para. 5-8).
	Defective delay multivibrator V3.	Replace V3 (para. 5-8).
	Defective width multivibrator V8 or V9.	Replace V8 and/or V9 (para. 5-8).
Unstable undelayed sync, delayed sync, and r-f output pulses.	Defective plus 250-volt supply.	Replace V34, V35, V36, and/or V37 (para. 5-8). At test point 7, check plus 250-volt supply. Adjust with +250 V ADJ R192.

TABLE VII. TROUBLESHOOTING CHART (cont)

TROUBLE	PROBABLE CAUSE	REMEDY
Irregular r-f output pulse, or pulse fades out over part of tuning range.	Incorrect voltage applied to klystron V13 repeller.	Check settings of tracking potentiometers R92, R93, R94, and/or R96 (para. 6-15).
Low or no r-f output; little or no reading on meter; video pulse output satisfactory.	Improper or no beam voltage at V13.	Reset -1250 V ADJ R155. Connect voltmeter to test point 10 (para. 6-14).
	Incorrect setting or drifting of beam current.	Adjust BEAM CURRENT ADJ R84 (para. 6-14) for meter pointer deflection to 0 DB mark with meter selector switch S6 in BEAM CURRENT position.
	Incorrect or no reflector voltage at V13.	Adjust track controls R92, R93, R94, and/or R96 (para. 6-15).
	Defective klystron V13.	Replace V13 (para. 5-8).
Erratic r-f output pulse; video pulse satisfactory, and r-f output satisfactory in CW position of MODULATION SELECTOR switch.	Incorrect repeller voltage at V13.	Adjust track controls R92, R93, R94, and/or R96 (para. 6-15).
	Defective klystron V13.	Replace V13 (para. 5-8).
No r-f pulse output; c-w output, delayed sync, and undelayed sync pulses satisfactory.	Defective blocking oscillator V4, defective multivibrator V8/V9, and/or defective pulse amplifier V10 and keyer V11.	Replace V4, V8, V9, V10, and/or V11 (para. 5-8).
C-w and pulsed r-f output satisfactory; no output in FM position of MODULATION SELECTOR.	Defective sawtooth generator V5 and/or V9.	Replace V5 and/or V9 (para. 5-8).
	Defective crystal rectifier CR4.	Replace CR4.
Undelayed sync satisfactory but multiple r-f output pulse obtained.	Defective crystal rectifier CR3.	Replace CR3.
Undelayed sync satisfactory but multiple delayed sync output pulses obtained.	Defective crystal rectifier CR2.	Replace CR2.
Cw r-f output satisfactory; no r-f output when external modulation signal applied to EXT MOD jack J10.	Defective external modulation amplifier V8/V9, and/or defective pulse amplifier V10 or keyer V11.	Replace V8, V9, V10, and/or V11 (para. 5-8).
Meter cannot be zero set with front-panel controls.	Bolometer R101 changed resistance.	Adjust COARSE BALANCE R211 (para. 6-17).
	Meter selector S6 in BEAM CURRENT position.	Reset S6 to POWER MONITOR position.
	Defective voltage amplifier V38 or power amplifier V39.	Replace V38 and/or V39 (para. 5-8).
	Defective crystal diode CR9.	Replace CR9.
	Defective bolometer R101.	Refer to depot maintenance.
Power monitor bridge zero sets and power sets correctly; r-f output low; output impedance too high (standing wave ratio at J13 much above 6 db).	Power receiving element R102 open.	Refer to depot maintenance.

TABLE VII. TROUBLESHOOTING CHART (cont)

TROUBLE	PROBABLE CAUSE	REMEDY
Cw output satisfactory in one range (7000-9000 mc, or 9000-10750 mc) but low in other range.	Mode switch S4 does not operate when cam is rotated.	Replace S4.
R-f output pulse and/or delayed sync output pulse does not occur on every cycle, but skips the second or third	PULSE DELAY control R17 improperly set for desired pulse repetition frequency.	Reset R17 so that delay in microseconds is less than 75 percent of pulse period (fig. 4-2).
	Bias of V4A and/or V4B out of adjustment.	Adjust R29 and/or R30 (para. 6-21).
Unstable regulation of d-c power supplies.	Defective beam power supply tubes V24-V31, or +250-volt supply tubes V34-V37.	Replace defective tubes.
	Improper voltage adjustments.	Adjust power supply controls (para. 6-14).
	Improper power source.	Connect signal generator to rated source (table III).

TABLE VIII. TEST-POINT ANALYSIS
(See figure 7-1 for schematic-diagram locations.)

TEST POINT	FIGURE NUMBER	DESCRIPTION	TEST POINT	FIGURE NUMBER	DESCRIPTION
1	6-10	Accessible through test-prod holes in fuse-holder caps. Check primary power and fuse continuity.	6	6-11	Test of -87-volt beam power supply. (pin 2 or 7 of V28)
2	6-11	Test of -1250-volt beam power supply. (junction R154 and R155)	7	6-11	Test of 250-volt power supply. (pin 9 of K2)
3	5-3	Test of -1358-volt keyer power supply. (socket 3 of P11)	8	6-11	Test of 108-volt power supply. (pin 5 of V36)
4	5-3	Test of -1700-volt repeller power supply. (socket 4 of P11)	9	6-11	Test of +175-volt power supply. (junction R188 and R189)
5	5-3	Test of -1100-volt repeller power supply. (socket 1 of P11)	10	5-3	Test of -1250-volt beam power supply. (socket 2 of P11)

WARNING

This equipment employs high voltages which are dangerous to life. Operating personnel must observe safety regulations at all times. Make certain power cable is disconnected before attempting repairs or replacement.

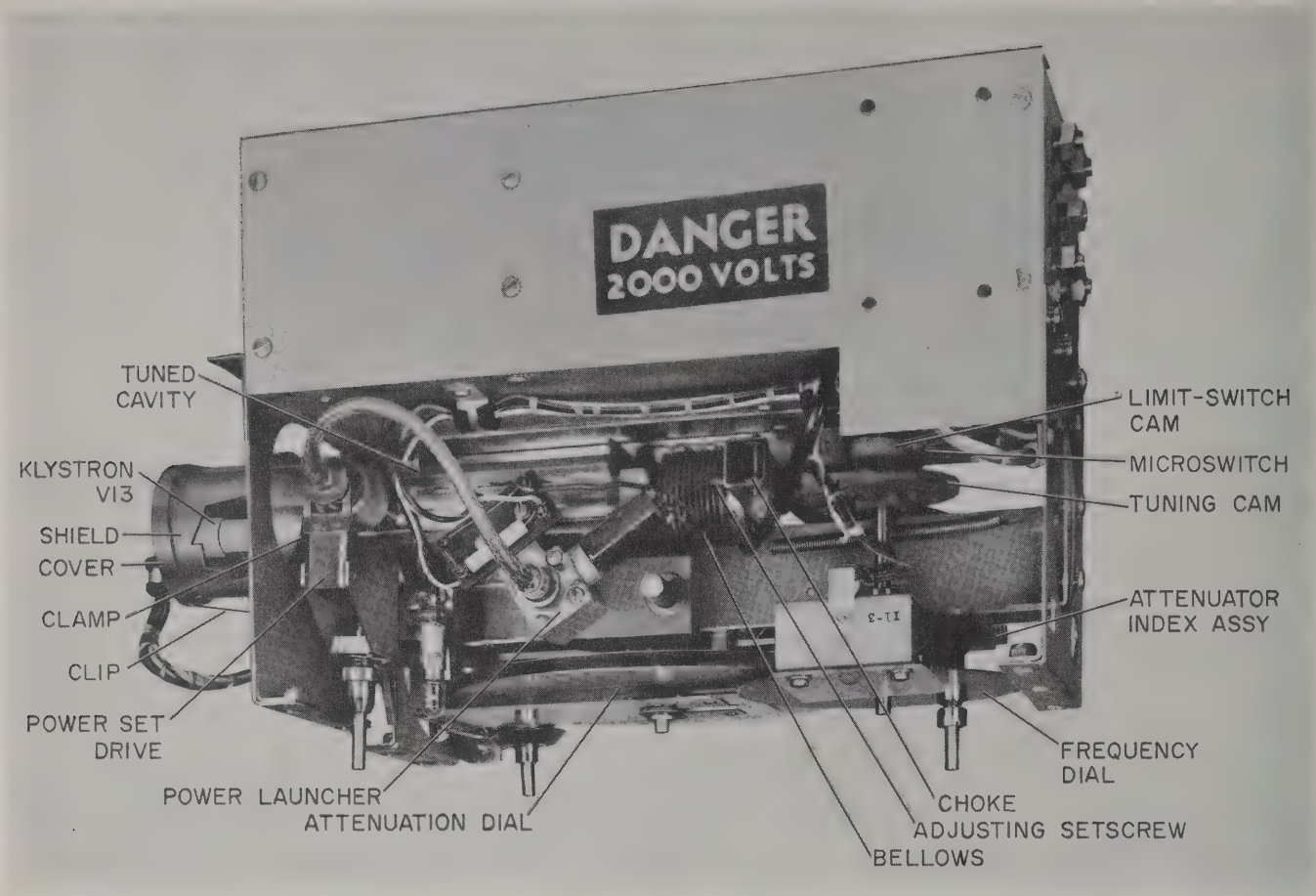


Figure 6-1. Keyer Chassis

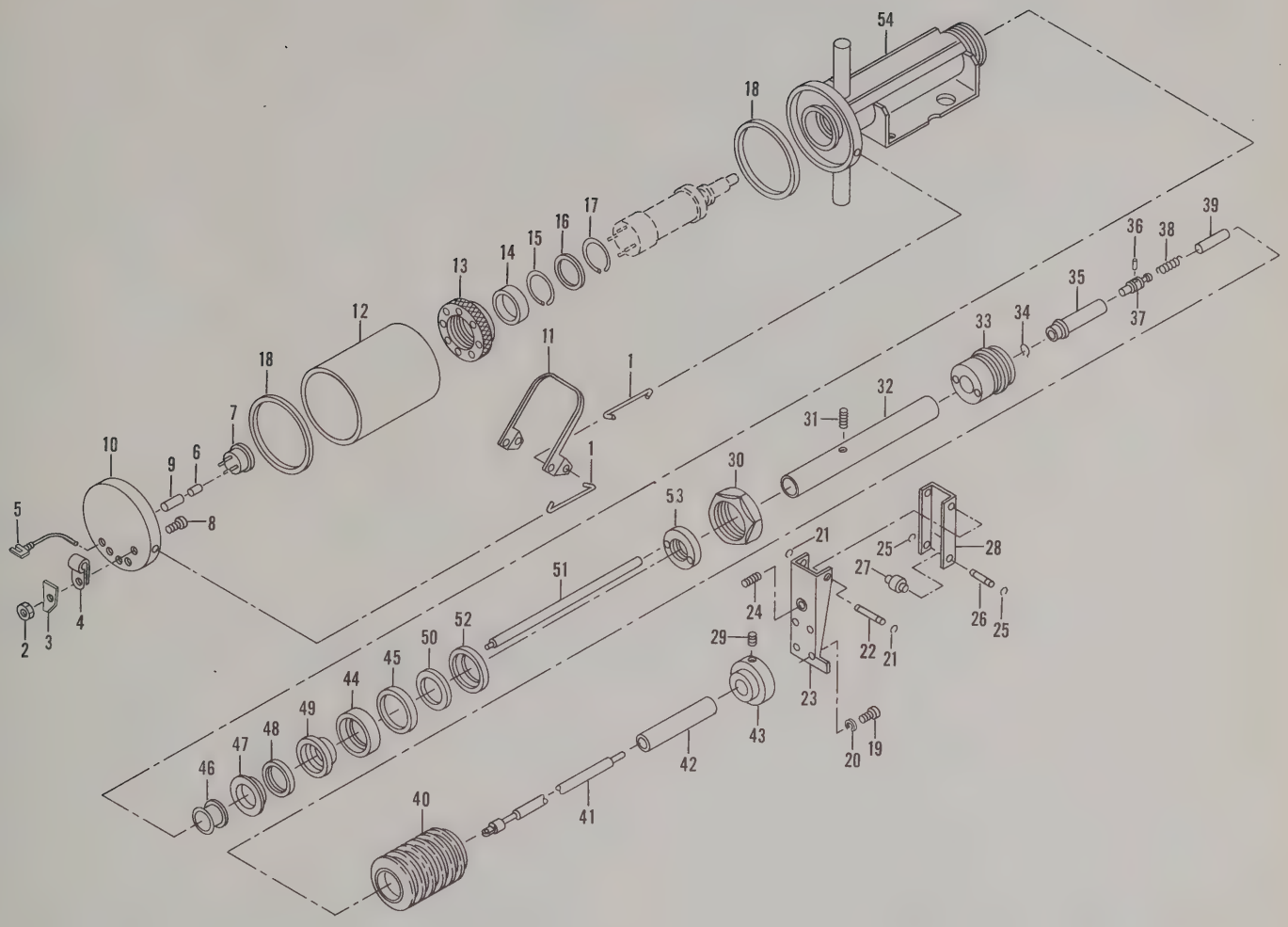
6-7. REPLACEMENT OF KLYSTRON OSCILLATOR V13. (See figures 6-1 and 6-2.)

6-8. The klystron oscillator tube V13 (figure 6-1) is seated within the tuned cavity Z2. To replace the tube, proceed as follows:

a. Remove power from signal generator.
b. Remove the signal generator from equipment case.
c. Lift clamp (11, figure 6-2) from locked position over shield (12). This will relieve tension from spring-wire clips (1).
d. Holding tube-shield cover (10) with one hand, gently pull tube socket (7) away from base of klystron tube V13.
e. Remove shield (12) from assembly.
f. Using spanner wrench furnished with the test set, loosen knurled nut (13) one-half turn counterclockwise from tuned cavity (54). Do not remove the nut.
g. Hold the external end of klystron tube and gently rotate clockwise while withdrawing it from the cavity.
h. Insert replacement tube into cavity. Gently push the tube into the center of the cavity and press it against a noticeable resistance, twisting slightly clockwise, until a positive stop is met.
i. Tighten knurled nut (13) with spanner wrench approximately one-half turn clockwise.
j. If the knurled nut (13) is accidently removed from the cavity, the retainer ring (14), springs (15 and 17), and washer (16) will be removed from the cavity with the tube. Install these items in the order shown in figure 6-2 before installing the knurled nut and tube.
k. Slide shield (12) over the end of the klystron tube while supporting clamp (11) over the shield.
l. Align tube socket (7) with base pins of klystron tube and press socket onto tube. Make certain it is aligned to avoid application of improper voltages.
m. Swing clamp (11) to the right until it rests on top of shield (12) to secure tube shield cover (10) against shield (12).
n. Check actual signal-generator frequency against frequency dial reading. If the readings vary by more than one percent, recalibrate the oscillator (paragraph 6-9).

6-9. CALIBRATION.

6-10. Check the calibration of the Signal Generator TS-622/U at least once every 90 days of use and each time a klystron tube is replaced to determine the actual generator frequency as compared to the reading of the frequency dial. If the variance is more than one percent, recalibrate the generator.



1. Spring clip
2. Nut
3. Terminal
4. Clamp
5. Terminal
6. Core
7. Tube socket
8. Machine screw
9. Tube
10. Cover
11. Clamp
12. Cylinder shield
13. Knurled nut
14. Retaining ring
15. Spring
16. Washer
17. Spring
18. R-F choke
19. Screw
20. Washer
21. Ring
22. Pin
23. Channel
24. Setscrew
25. Ring
26. Pin
27. Cam follower
28. Bracket
29. Setscrew
30. Nut
31. Setscrew
32. Tube
33. Sleeve
34. Ring
35. Retainer
36. Pin
37. Connector
38. Spring
39. Tube
40. Bellows
41. Rod
42. Support
43. Hub
44. Sleeve
45. Sleeve
46. Sleeve
47. Flange
48. Insulator
49. Choke body
50. Insulator
51. Choke
52. Push rod
53. Core
54. Tuned cavity

Figure 6-2. Klystron Oscillator Assembly, Exploded View

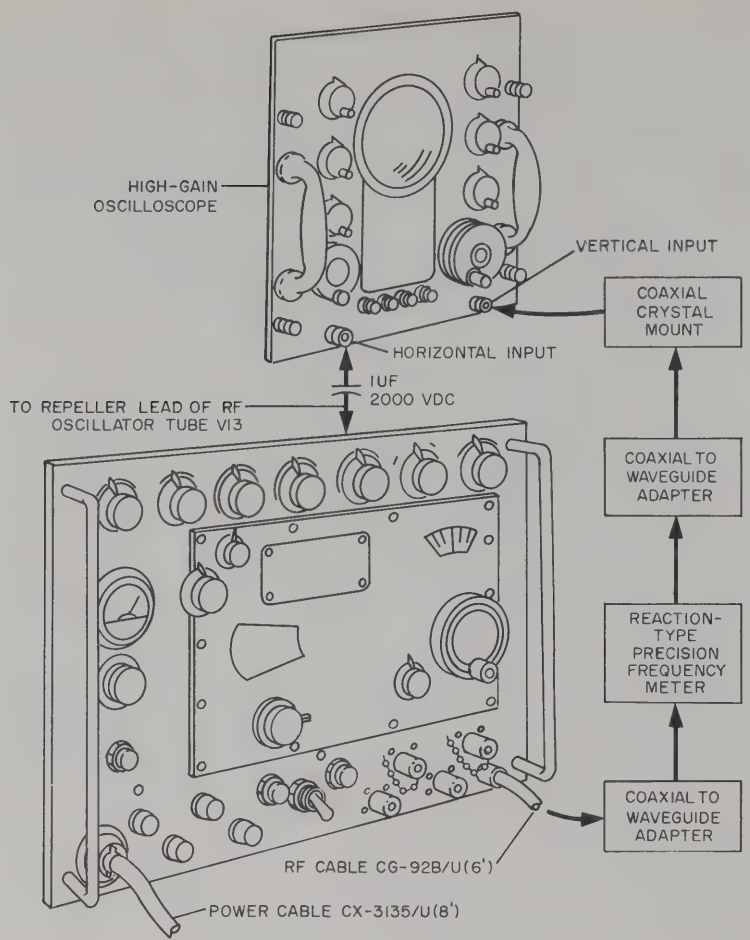


Figure 6-3. Frequency-Calibration Test Set-Up

6-11. PRE-OPERATING CHECK. Refer to paragraph 3-3.

6-12. FREQUENCY CALIBRATION. (See figure 6-3 and table VI.)

a. Connect coaxial-to-waveguide adapter to RF OUTPUT J13 with r-f cable CG-92B/U (6').
b. Connect adapter to input of frequency meter equivalent to Hewlett-Packard X530A.
c. Connect frequency-meter output to a second coaxial-to-waveguide adapter.
d. Connect second adapter to a coaxial crystal mount using a crystal diode 1N23B.
e. Connect inner conductor of crystal mount to vertical input of oscilloscope.
f. Connect outer conductor of crystal mount to oscilloscope ground.

WARNING

Be aware of high voltages. Remove power whenever possible. If adjustments must be made with power on, use insulating gloves and tools.

g. Remove top cover of keyer chassis and connect a clip lead to the standoff terminal on the keyer chassis near the potentiometer R95. This terminal is the output of the repeller of klystron oscillator V13.
h. Connect the other end of the lead to a d-c blocking capacitor, 1 microfarad, 2000 vdcw.
i. Connect capacitor to horizontal input of oscilloscope.
j. Connect common ground between signal generator and oscilloscope.
k. Rotate BEAM CURRENT ADJ R84 (figure 5-2) to extreme counterclockwise position.
l. Apply power to signal generator and to test equipment.
m. Turn MODULATION SELECTOR S3 to CW position. Allow signal generator to warm up for at least 20 minutes.
n. Turn SYNC SELECTOR S1 to INT.
o. Turn RATE MULTIPLIER S2 and PULSE RATE R41 to select any desired sweep rate between 40 and 4000 sweeps per second.
p. Set METER SELECTOR S6 (figure 5-3) to BEAM CURRENT position.
q. Loosen shaft lock of BEAM CURRENT ADJ R84 and turn potentiometer shaft until pointer of meter M1 deflects to red-line calibration mark. Tighten shaft lock.

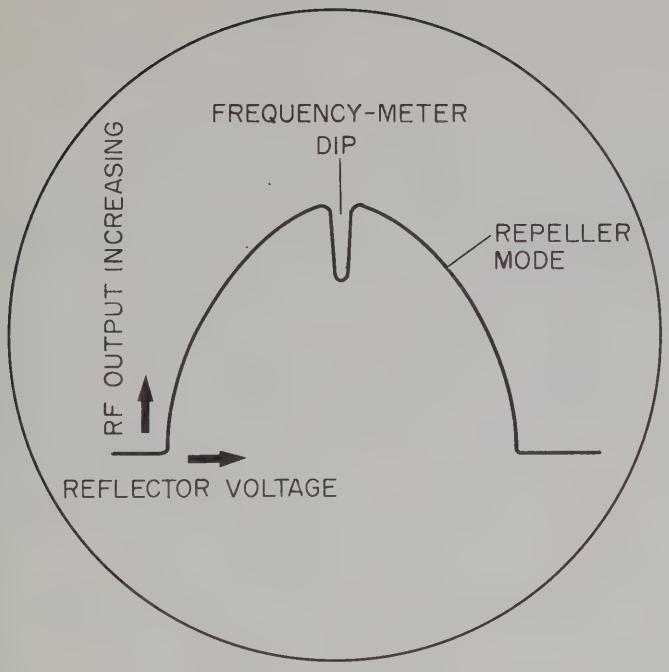


Figure 6-4. Typical Repeller Mode Plot

r. Set METER SELECTOR S6 at POWER MONITOR.
s. Turn MODULATION SELECTOR to FM position.
t. Turn POWER SET control midway between extreme limits of rotation.
u. Turn OUTPUT ATTENUATOR until mechanical stop near -10 DBM calibration mark prevents further rotation.
v. Trace of repeller mode on oscilloscope should be as in figure 6-4.
w. Turn SIGNAL FREQUENCY control until 10,750 megacycle calibration mark is directly under hairline.
x. Set frequency meter at 10,750 megacycles.
y. Adjust SIGNAL FREQUENCY control until frequency-meter dip appears as close as possible to center of repeller-mode trace.
z. The SIGNAL FREQUENCY control should be within ±108 megacycles of 10,750 megacycles. If setting is incorrect, adjust setscrew in choke (figure 6-1) until frequency meter dip is at center of repeller-trace mode (figure 6-4).

Note

Signal Generator TS-622/U employs the 3-3/4-cycle repeller mode over frequency range of 7000 to approximately 9000 megacycles. The mode is switched automatically to 4-3/4-cycle mode through the tuning cam and microswitch (figures 6-1 and 6-7).

aa. Replace frequency meter with one equivalent to Hewlett-Packard Model J530A. Set meter at 7000 megacycles.
bb. Turn SIGNAL FREQUENCY control until frequency-meter dip appears close to center of repeller-mode trace on oscilloscope.
cc. If signal-frequency reading varies more than 70 megacycles from 7000 megacycles, loosen screws holding frequency dial (figure 6-1), set 7000-megacycle dial reading under hairline, and tighten screws.

6-13. TUNING-CAM ADJUSTMENT. Check accuracy of SIGNAL FREQUENCY calibration against actual signal-generator output over entire range. Connect RF OUTPUT to Frequency Meter TS-186/UP. Apply power. If accuracy of dial calibration varies by more than one percent from actual output frequency, adjust tuning cam as follows:

a. Turn frequency dial so that cam follower is at fixed section of tuning cam (figures 6-1 and 6-5).
b. Adjust screw on choke until measured frequency on frequency meter matches frequency-dial reading under hairline.
c. Loosen four locknuts on rear of tuning cam one-half turn counterclockwise.
d. Turn frequency dial until cam follower is adjacent to one of the eccentric bolts on cam.
e. Turn bolt until indicated frequency on dial is the same as measured frequency. Tighten locknut.
f. Repeat adjustment at each of the remaining adjustment bolts. Tighten each locknut after completing adjustment at its bolt.

Note

At extreme limits, set adjustment bolt as close as possible to cam follower. Exact positioning adjacent to cam follower may not be possible.

6-14. REPELLER-VOLTAGE CALIBRATION.

a. Turn METER SELECTOR S6 (figure 5-3) to POWER MONITOR POSITION.
b. Turn MODULATION SELECTOR to ZERO SET.
c. Adjust ZERO SET coarse and FINE controls until meter M1 pointer deflects to left-hand ZERO SET.
d. Turn MODULATION SELECTOR to CW.
e. Turn POWER SET control until meter pointer deflects to red line zero DB calibration.
f. Rotate SIGNAL FREQUENCY control over entire frequency range. If POWER SET control can be adjusted to obtain more than a zero DB reading on the meter, no repeller-voltage tracking adjustment is required. If POWER SET control cannot be so adjusted, proceed as follows:
(1) Remove power from signal generator.
(2) Disconnect plug P11 from jack J11 (figure 5-4).
(3) Insert Multimeter TS-297/U negative test prod into socket numbered 2 on P11. Ground positive test lead of multimeter on signal-generator chassis.
(4) Apply power and allow set to warm up for one minute.
(5) Adjust -1250V ADJ R155 (figure 6-6) for reading of -1250 volts on multimeter.
(6) Remove multimeter and connect plug P11 to jack J11.
(7) Turn METER SELECTOR S6 to BEAM CURRENT position.
(8) Adjust BEAM CURRENT ADJ R84 (figure 5-2) until meter M1 pointer deflects to red-line calibration mark.
(9) Turn METER SELECTOR S6 to POWER MONITOR position.

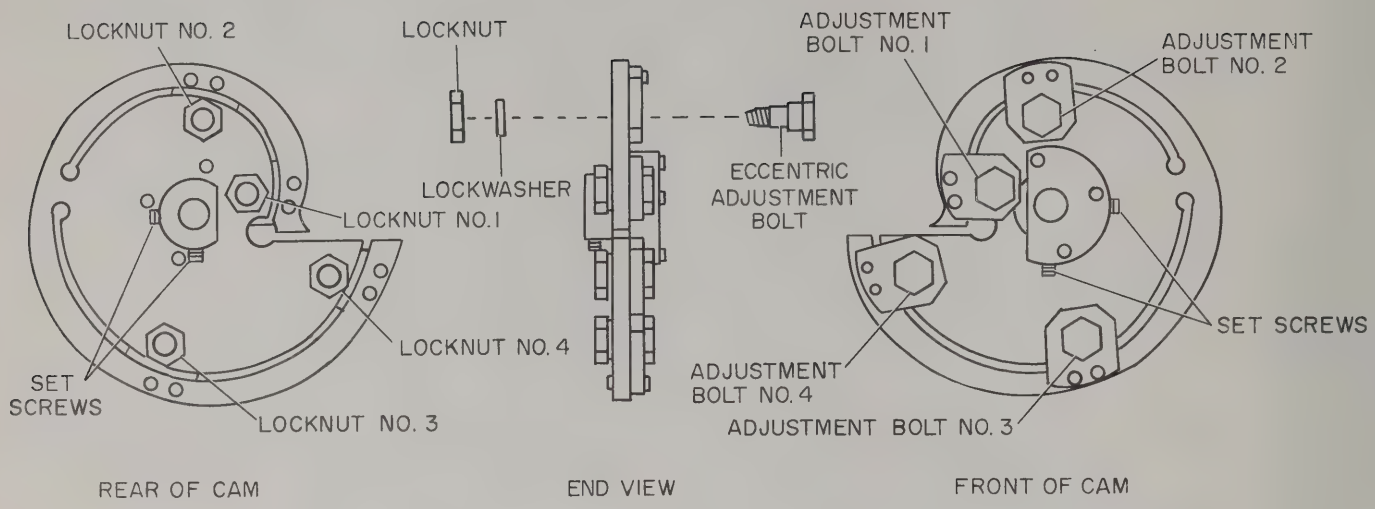


Figure 6-5. Tuning-Cam Adjustment

(10) Turn SIGNAL FREQUENCY control past 9000-megacycle calibration and listen for click of repeller mode switch. See figure 6-7 for repeller voltage characteristics and required switchover point at 9000 megacycles. If no click is heard, remove power.
(11) Loosen setscrews in limit-switch cam (figure 6-1) and reset cam on shaft so that microswitch is actuated at 9000-megacycle position of frequency dial. Tighten setscrews.
(12) Apply power and recheck cam setting.

6-15. TRACKING-POTENTIOMETER CALIBRATION.

a. Connect instrumentation as described for frequency calibration in steps a through j of paragraph 6-12.
b. Set signal generator and frequency meter at a frequency slightly less than 9000 megacycles.
c. Turn FM AMPLITUDE control to extreme counterclockwise position. The mode trace on oscilloscope should disappear symetrically about the center, with center portion disappearing last.
d. If mode trace does not disappear in this manner, adjust TRACK 2 R92 (figure 5-2) until trace does disappear.
e. Set signal generator and frequency meter at frequency slightly above 9000 megacycles.
f. Turn FM AMPLITUDE control to extreme clockwise position. If mode trace does not disappear, adjust TRACK 3 R93 (figure 5-2) until it does.
g. Set frequency at 10,750 megacycles and repeat steps c through f above, adjusting TRACK 4 R94 control (figure 5-2).
h. Using frequency meter equivalent to Hewlett-Packard J530A for range between 7000 and 8200

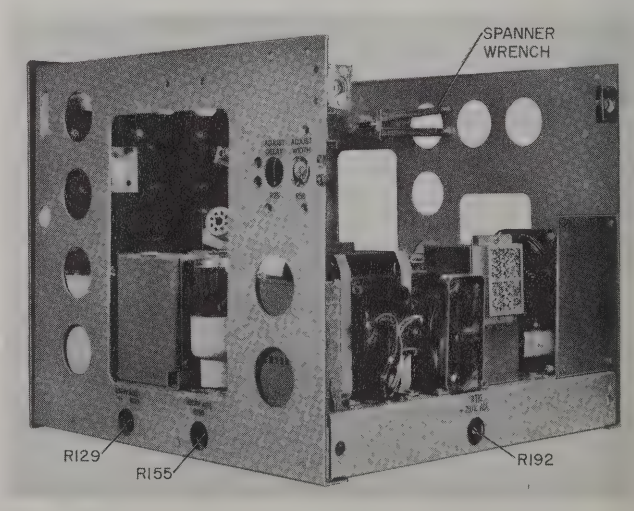


Figure 6-6. Signal-Generator Adjustment Points

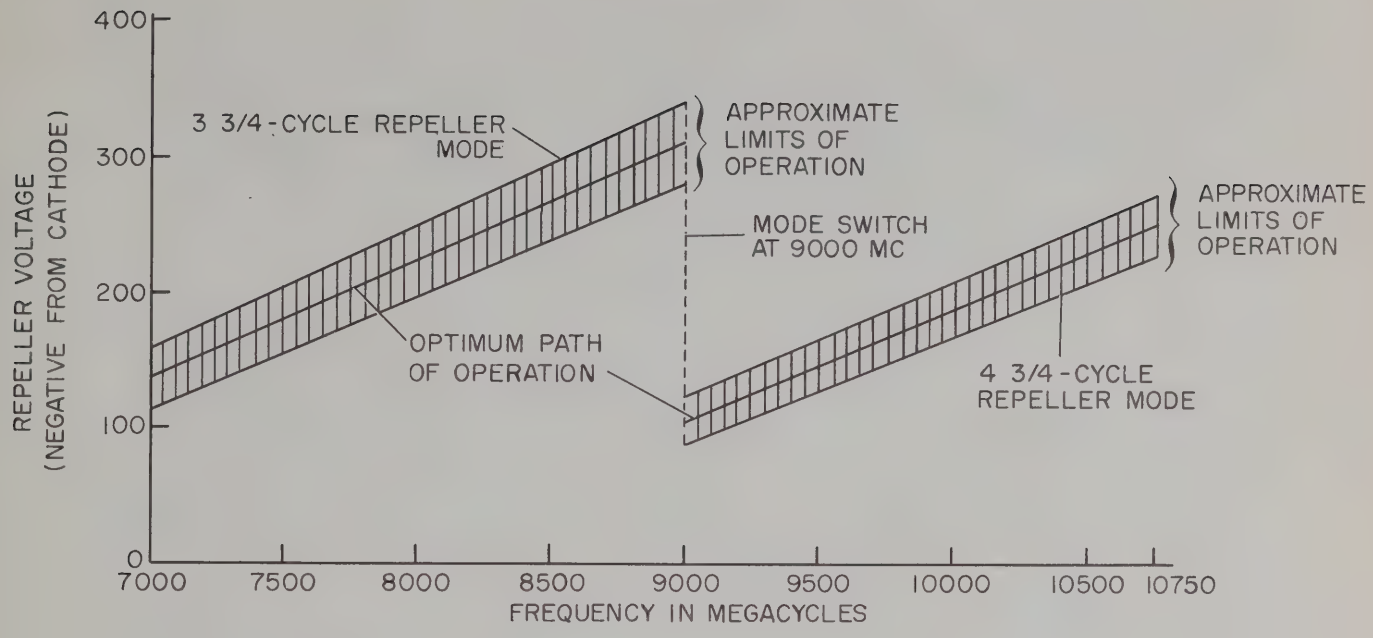


Figure 6-7. Repeller Voltage Characteristics

megacycles, repeat adjustments in c through f above at frequencies below and above 7000 megacycles and adjusting TRACK 1 R96 control, if necessary.

i. If TRACK 1 R96 control had to be adjusted in step h above, repeat steps c through g.

j. Set MODULATION SELECTOR at CW and repeat steps b through g above.

k. Turn MODULATION SELECTOR to INT. Turn SYNC SELECTOR to INT. Adjust RATE MULTIPLIER and PULSE RATE controls for pulse repetition frequency of 1000 pulses per second.

l. Repeat steps b through i above.

6-16. REPELLER VOLTAGE-SUPPLY CALIBRATION.

a. Disconnect plug P11 from J11 (figure 5-4) and insert positive lead of multimeter TS-297/U into socket 2 of P11.

b. Insert negative lead of multimeter into socket 4 of P11.

c. Apply power to signal generator. Multimeter reading should be 450 volts dc.

d. If necessary, adjust -1700V ADJ R129 (figure 6-6) until 450-volt reading is obtained.

e. If adjustment of -1700V ADJ R129 was necessary, perform tracking-potentiometer calibration (paragraph 6-15).

6-17. METER SENSITIVITY-CONTROL CALIBRATION.

a. Clip test lead of Multimeter TS-297/U either to ungrounded terminal of C48 (connected to socket 6 of jack J12) or to terminal 4 of transformer T10. Connect other test lead to chassis ground.

b. Turn MODULATION SELECTOR to ZERO SET.

c. Adjust ZERO SET coarse and FINE controls until multimeter reading is 1.15 volts.

d. If 1.15-volt reading cannot be obtained, unlock shaft of COARSE BALANCE R211 (figure 6-8) and adjust until reading is attained.

e. Pointer of meter M1 should be at ZERO SET. If not, adjust METER SENSITIVITY R206 (figure 6-8) until pointer is precisely at ZERO SET.

f. Recheck 1.15-volt reading on multimeter.

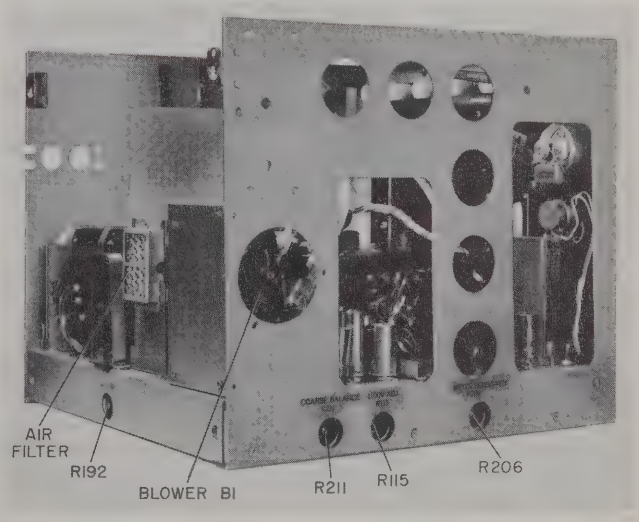


Figure 6-8. Signal-Generator Adjustment Points

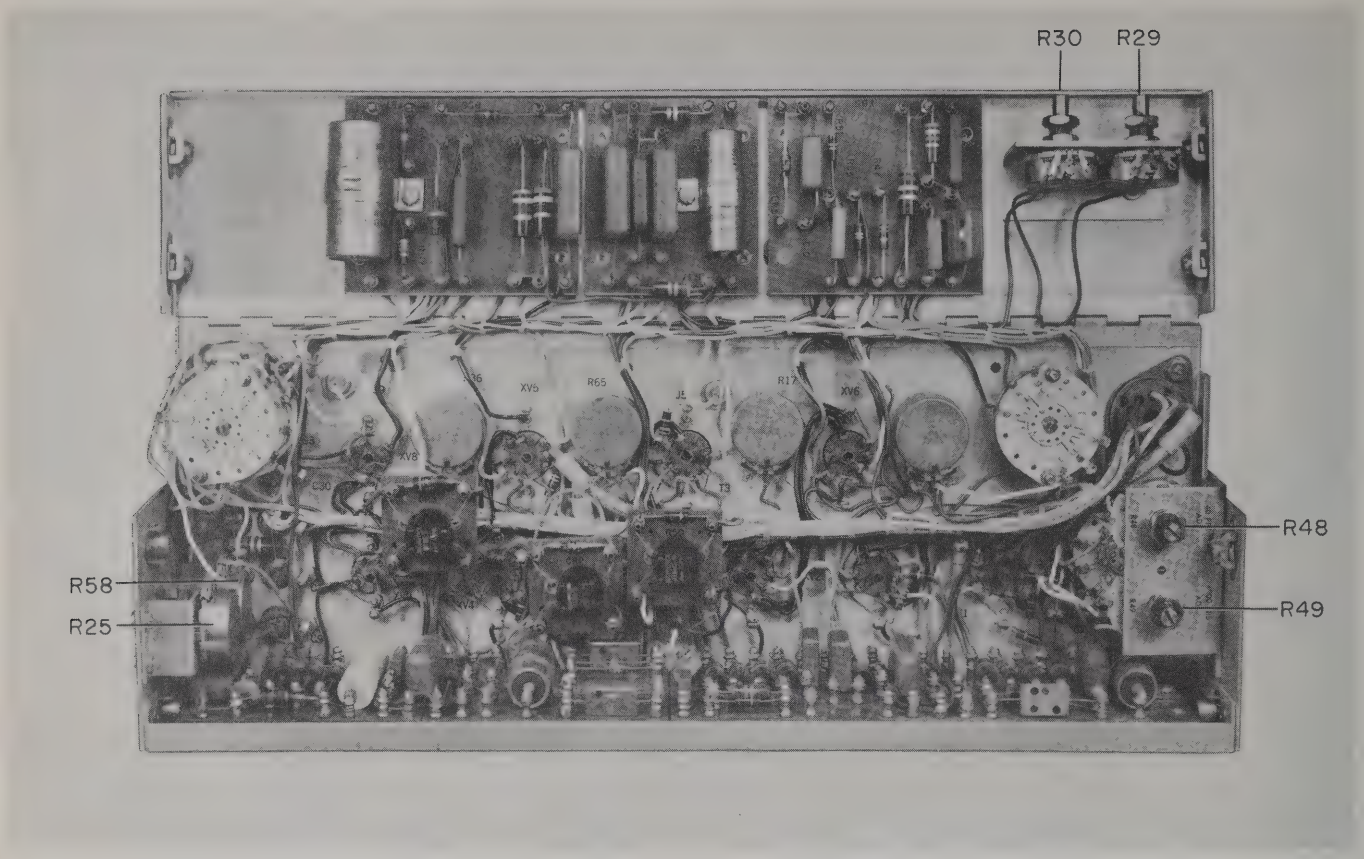


Figure 6-9. Modulator-Chassis Adjustments

6-18. PULSE-RATE CALIBRATION.

Note

Recalibrate pulse rate whenever the rate multivibrator V6 or any of its stage components are replaced, or whenever the pulse rate is found to differ from a standard signal source.

a. Connect plate (pin 1) of multivibrator V3 to vertical input of Oscilloscope AN/USM-24.
b. Connect output of Audio Oscillator TS-382/U to horizontal amplifier of oscilloscope.
c. Connect output of audio oscillator, through 1000 microfarad capacitor, to vertical amplifier of oscilloscope.
d. Apply power.
e. Turn SYNC SELECTOR to INT.
f. Turn RATE MULTIPLIER to X1.
g. Turn PULSE RATE to 40.
h. Turn PULSE DELAY to 150.
i. Turn PULSE WIDTH to midpoint between extremes of travel.
j. Turn MODULATION SELECTOR to INT.
k. Adjust audio oscillator to produce output of exactly 40 cycles per second.
l. The oscilloscope trace should be a stationary ellipse with a rotating pip.
m. Unlock and adjust 40 PPS ADJ R48 (figure 6-9) until trace remains stationary and a single pip, open at the elliptical base line, is obtained.
n. Turn PULSE RATE to 400. Turn RATE MULTIPLIER to X10.
o. Set audio oscillator to produce exactly 4000 cycles per second.
p. Unlock and adjust 4000 PPS ADJ R49 (figure 6-9) until required pattern of elliptical trace with single pip is obtained.
q. Recheck setting of 40 PPS ADJ R48.

6-19. PULSE-DELAY CALIBRATION.

a. Connect between UNDELAYED SYNC jack on front panel to trigger input for horizontal sweep of synchroscope.
b. Connect DELAYED SYNC jack to vertical input of synchroscope.
c. Apply power. Set SYNC SELECTOR at INT, RATE MULTIPLIER at X1, PULSE RATE at 40, PULSE WIDTH at midpoint position, and MODULATION SELECTOR at INT.
d. Turn PULSE DELAY to 300. Pip should appear at 300 microsecond marker of synchroscope time-base line.
e. If necessary, set ADJUST DELAY R25 (figure 6-10) until pip is as required.

6-20. PULSE-WIDTH CALIBRATION.

a. Connect DELAYED SYNC jack on front panel to horizontal sweep of synchroscope.

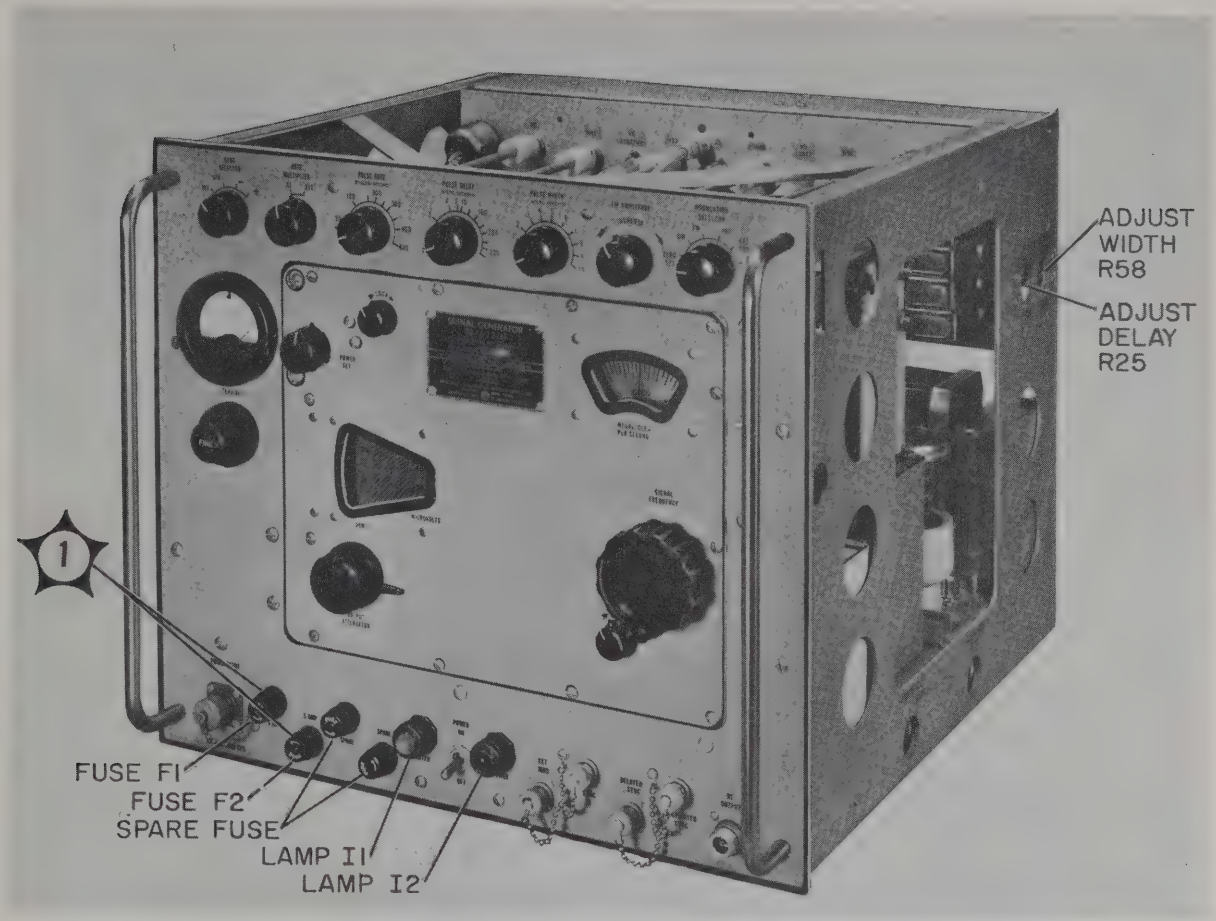


Figure 6-10. Modulator-Chassis Adjustments

b. Connect RF OUTPUT jack, through crystal detector, to vertical input of synchroscope.
c. Apply power. Turn PULSE WIDTH to 10.
d. A rectangular pip should be at the 10-microsecond mark on the synchroscope sweep.
e. If necessary, set ADJUST WIDTH R58 (figure 6-10) until pip is as required.

6-21. BIAS CALIBRATION.

Note

Do not attempt to reset bias controls R29 and R30 unless all other modulator adjustments do not correct malfunctioning. Adjustment may be required when transformer T1 or T2 is replaced.

a. Connect power to POWER INPUT jack through a variac.
b. Connect UNDELAYED SYNC jack to trigger input for horizontal sweep of synchroscope. Connect DELAYED SYNC jack to vertical input of synchroscope.
c. Set MODULATION SELECTOR to INT.
d. Set variac for 130-volts a-c input to signal generator.
e. Set SYNC SELECTOR at SIN, "-", or "+". Do not apply any signal to SYNC IN jack.
f. Set RATE MULTIPLIER at X10.
g. Turn PULSE RATE control fully clockwise.
h. Turn PULSE DELAY control fully counterclockwise.
i. Turn PULSE WIDTH control fully clockwise.
j. Turn ADJUST V4A BIAS R29 and ADJUST V4B BIAS R30 (figure 6-9) fully counterclockwise. There should be no vertical deflection on screen and no trigger output from signal generator.
l. Turn ADJUST V4B BIAS R30 clockwise until vertical deflection appears on synchroscope trace. Turn R30 counterclockwise about 15 degrees until no vertical deflection is seen.
m. Turn ADJUST V4A BIAS R29 clockwise until vertical deflection appears.
n. Turn ADJUST V4A BIAS R29 counterclockwise about 15 degrees until sweeps and vertical deflection disappear.
o. Set variac output at 100 volts.
p. Turn SYNC SELECTOR to INT.
q. Set RATE MULTIPLIER and PULSE RATE for 4000 pulses per second.
r. Turn PULSE DELAY fully counterclockwise.
s. Set PULSE WIDTH at 10.
t. While observing synchroscope screen, turn PULSE

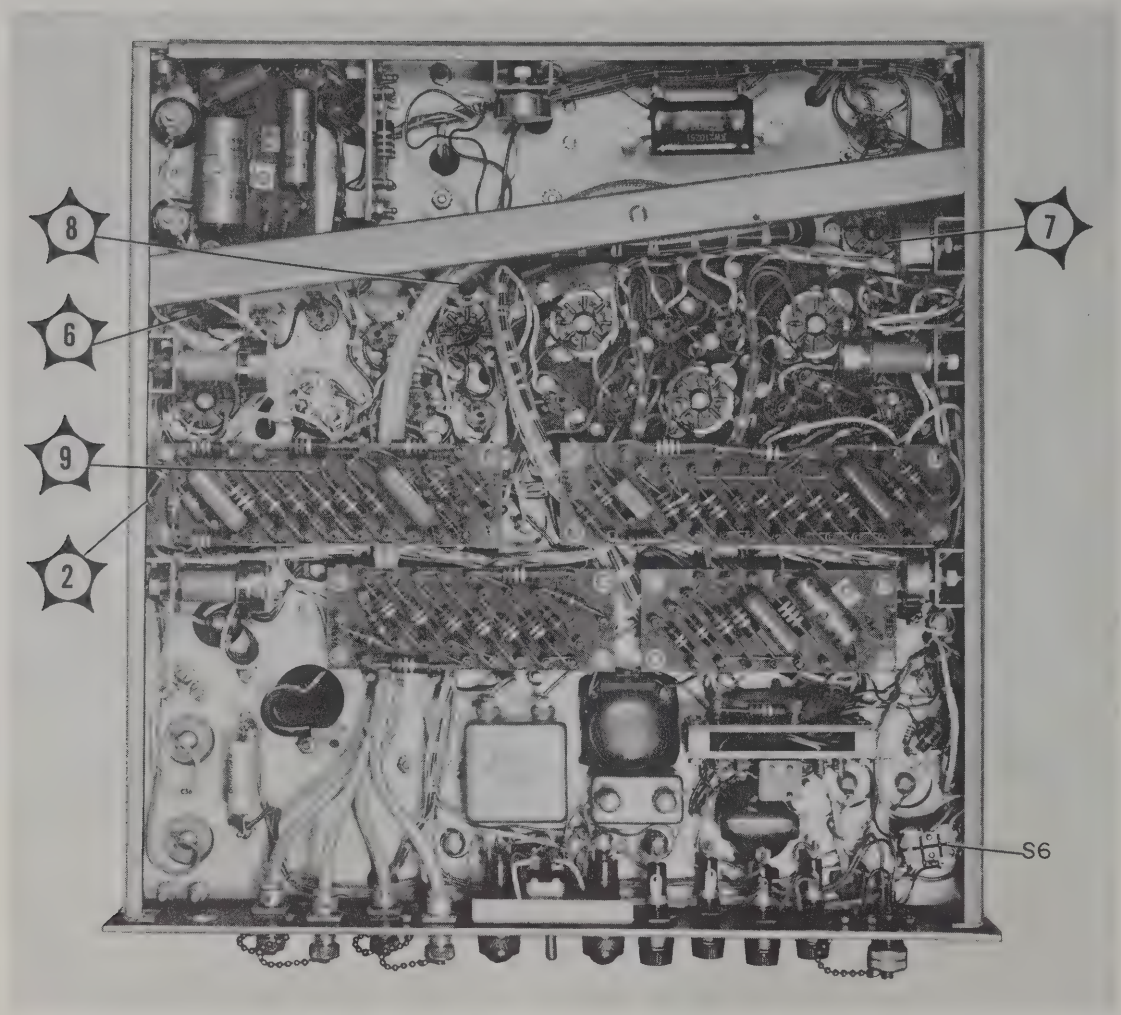


Figure 6-11. Main Chassis Components

DELAY from fully counterclockwise to fully clockwise position. If synchroscope indicates that signal generator is delivering proper output pulses, with no pulses missing, the modulator is performing as required under conditions of maximum pulse repetition frequency and low line voltage.

u. Set variac for 130 volts.

v. Set RATE MULTIPLIER and PULSE RATE for 40 pulses per second.

w. Set PULSE DELAY at 300 microseconds.

x. Set PULSE WIDTH at 10.

y. The synchroscope trace should indicate that output pulses are synchronized with output of signal-generator undelayed sync output and that there are no extraneous pulses at the beginning of each delay period that cannot be trimmed by resetting PULSE DELAY control.

z. If observations in steps t and y above are not as required, readjust bias controls as outlined in c through n above.

6-22. FINAL SIGNAL-GENERATOR TEST.

6-23. After completing adjustments and calibrations outlined in this section, check performance of signal generator against that of another signal generator of the same type known to be accurate. Refer to figures 5-3, 6-10, and 6-11 for pictorial locations of test points and to figure 7-1 for schematic- diagram locations should further testing be found necessary.

SECTION VII

DIAGRAMS

7-1. DESCRIPTION.

7-2. Figure 7-1 is a complete schematic diagram of the Signal Generator TS-622/U. Figures 7-2 through 7-4 are voltage and resistance charts for the main chassis, modulator chassis, and keyer chassis. These charts are intended for use in troubleshooting to localize troubles to a particular component in a stage after the trouble has been localized to that stage through use of the troubleshooting charts, tables VII and VIII.

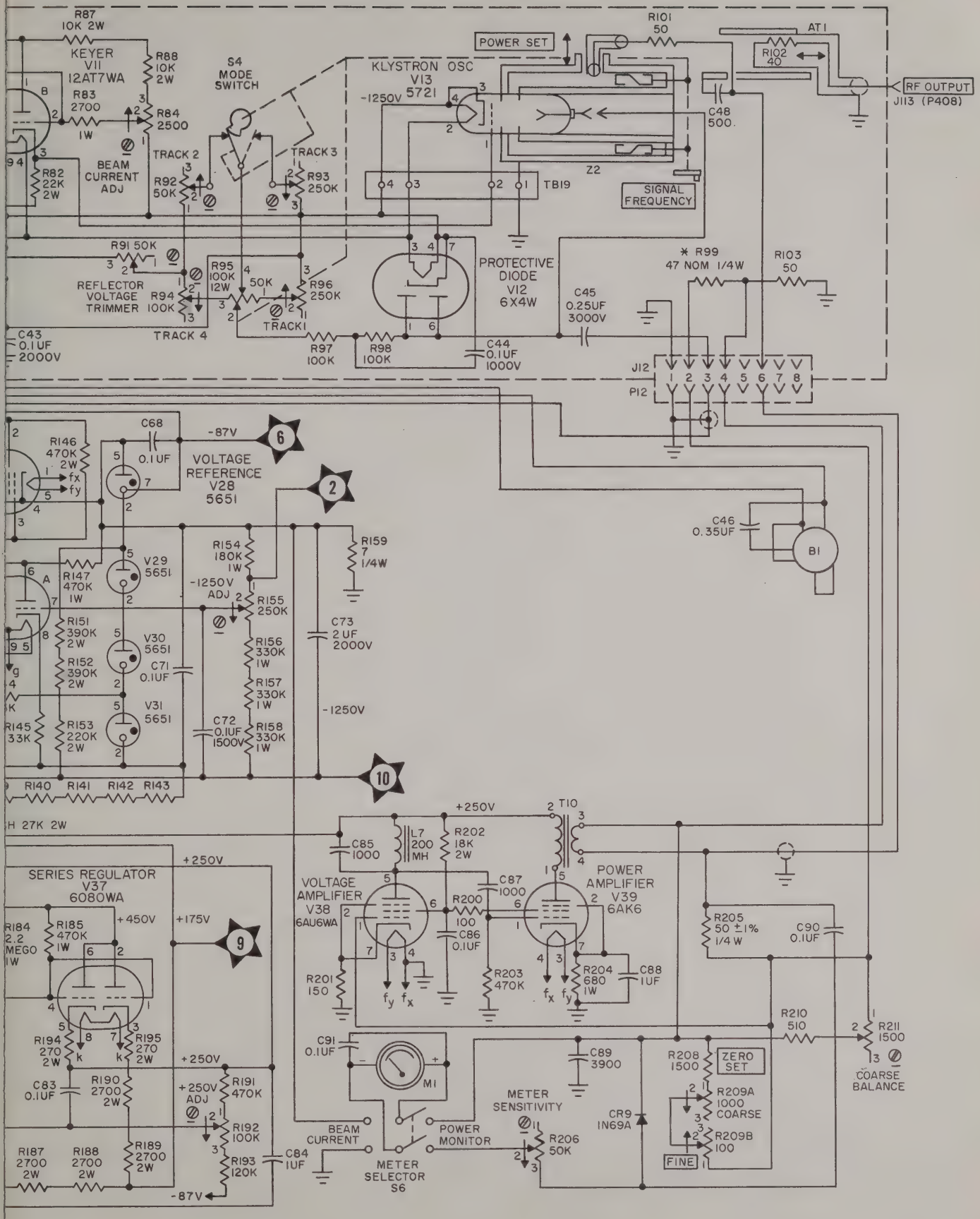
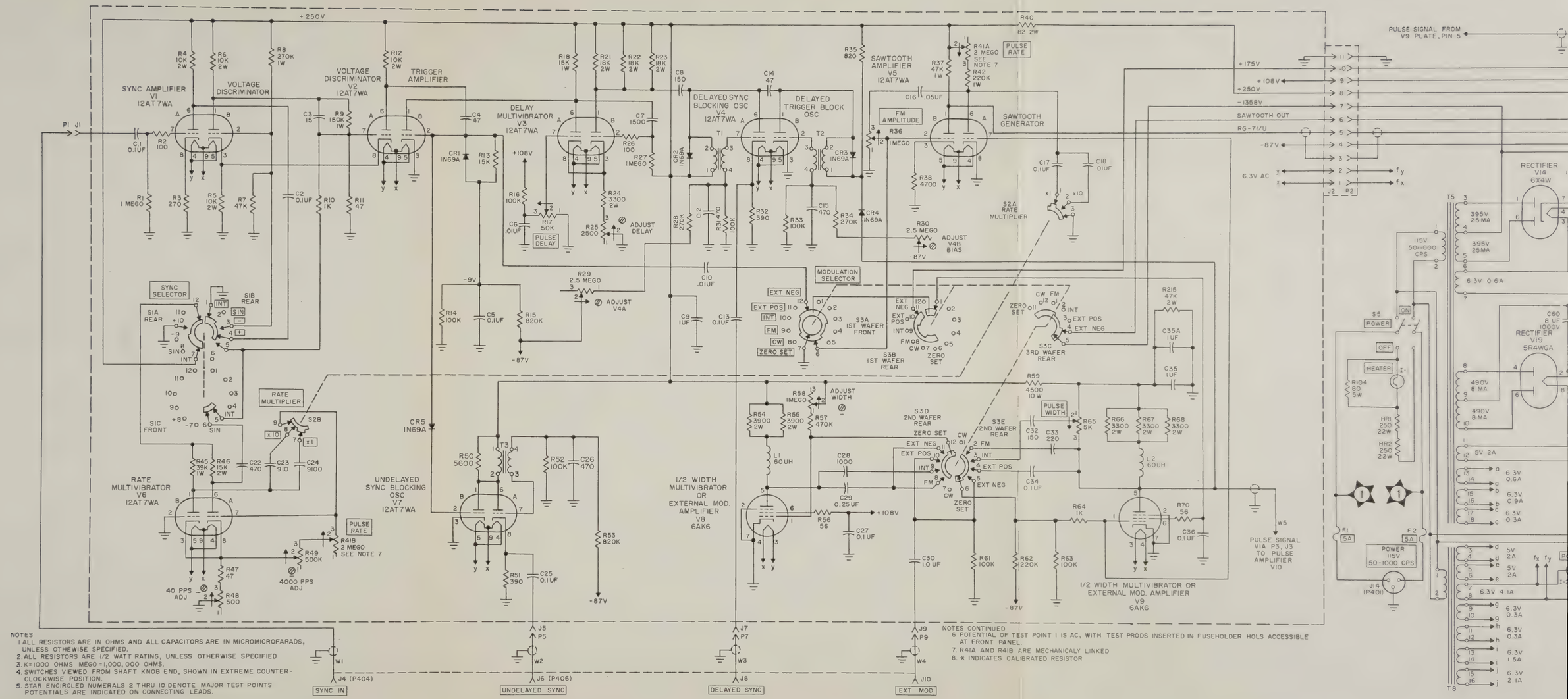


Figure 7-1. Signal Generator TS-622/U, Schematic Diagram



NOTES

1. ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN MICROMICROFARADS, UNLESS OTHEWISE SPECIFIED.
2. ALL RESISTORS ARE 1/2 WATT RATING, UNLESS OTHERWISE SPECIFIED
3. K=1000 OHMS MEGO =1,000,000 OHMS.
4. SWITCHES VIEWED FROM SHAFT KNOB END, SHOWN IN EXTREME COUNTER-CLOCKWISE POSITION.
5. STAR ENCIRCLED NUMERALS 2 THRU 10 DENOTE MAJOR TEST POINTS POTENTIALS ARE INDICATED ON CONNECTING LEADS.

NOTES CONTINUED

6. POTENTIAL OF TEST POINT 1 IS AC, WITH TEST PRODS INSERTED IN FUSEHOLDER HOLS ACCESSIBLE AT FRONT PANEL
7. R41A AND R41B ARE MECHANICALY LINKED
8. * INDICATES CALIBRATED RESISTOR

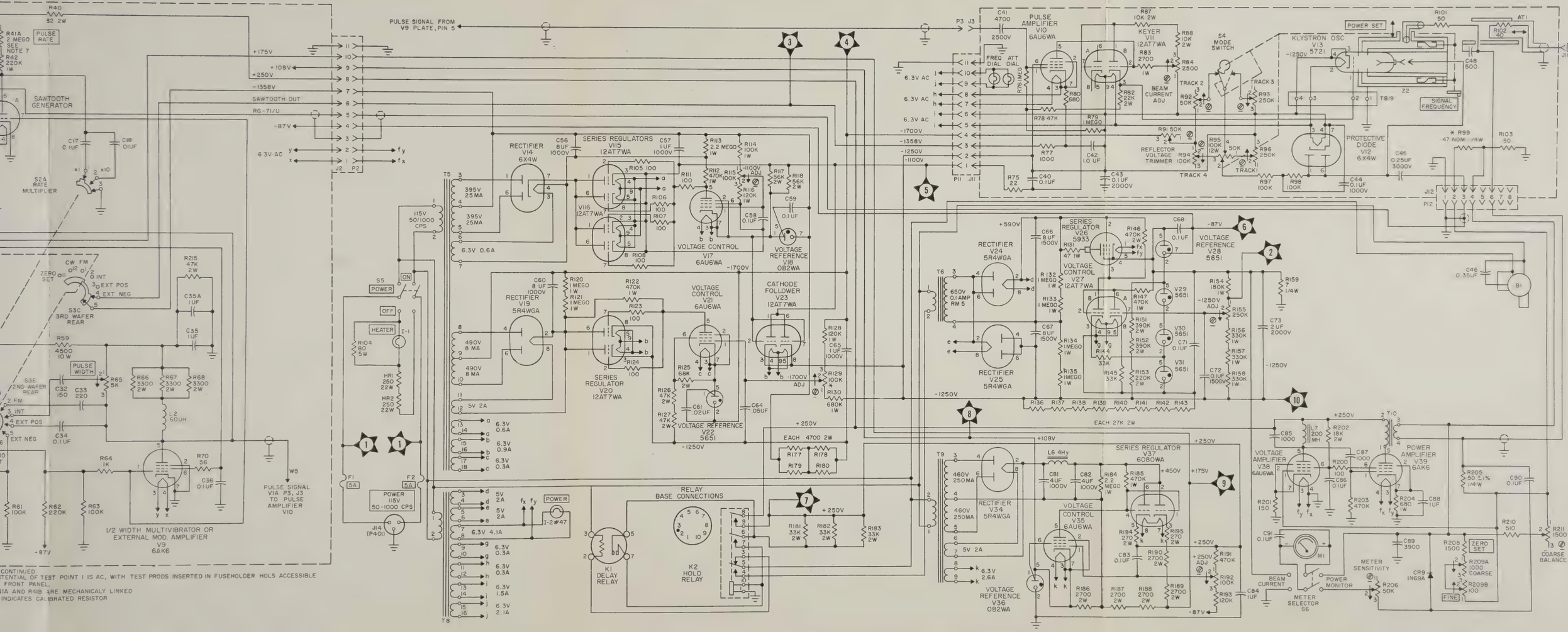


Figure 7-1. Signal Generator TS-622/U, Schematic Diagram

NOTES

All voltage measurements are dc to ground, unless otherwise indicated.

Voltmeter is 20,000 ohms-per-volt instrument.

All resistance measurements are to ground, unless otherwise indicated.

Control settings:

SYNC SELECTOR:	INT
MODULATION SELECTOR:	INT
PULSE RATE:	100
RATE MULTIPLIER:	X10
PULSE DELAY:	2.5
PULSE WIDTH:	10

V14

Pin 1 -	810VAC 7.5K
2 -	—
3 -	6.3VAC 0.8
4 -	6.3VAC
5 -	—
6 -	-870VAC 3MEGO
7 -	-870V

V15

Pin 1 -	-870V 3MEGO
2 -	-1100V 3MEGO
3 -	-1100V 630K
4 -	6.3VAC 0.2
5 -	6.3VAC 0.2
6 -	-870V 3MEGO
7 -	-1100V 4MEGO
8 -	-1100V 630K
9 -	6.3VAC 0.2

V16

Pin 1 -	-870V 3MEGO
2 -	-1100V 3MEGO
3 -	-1100V 630K
4 -	6.3VAC 0.2
5 -	6.3VAC 0.2
6 -	-870V 3MEGO
7 -	-1100V 4MEGO
8 -	-1100V 630K
9 -	6.3VAC 0.2

V17

Pin 1 -	-1250V 700K
2 -	-1250V 650K
3 -	6.3VAC 0.2
4 -	6.3VAC 0.2
5 -	-1100V 2.5MEGO
6 -	-1100V 620K
7 -	-1250V 650K

V18

Pin 1 -	-1250V 650K
2 -	—
3 -	—
4 -	—
5 -	-1250V 650K
6 -	—
7 -	-1358V 600K

V19

Pin 1 -	—
2 -	5VAC 0.1 -1800V
3 -	—
4 -	980VAC 1K
5 -	—
6 -	980VAC 1K
7 -	—
8 -	5VAC 0.1

V20

Pin 1 -	-1100V 2MEGO
2 -	-1250V 3MEGO
3 -	-1250V 600K
4 -	6.1VAC 0.2
5 -	6.1VAC 0.2
6 -	-1100V 2MEGO
7 -	-1250V 3MEGO
8 -	-1250V 600K
9 -	6.1VAC 0.2

V21

Pin 1 -	-1600V 950K
2 -	-1600V 770K
3 -	6.5VAC 0.4
4 -	6.5VAC 0.4
5 -	-1250V 3MEGO
6 -	-1450V 700K
7 -	-1600V 780K

V22

Pin 1 -	-1600V 750K
2 -	-1700V 850K
3 -	—
4 -	—
5 -	-1600V 750K
6 -	—
7 -	—

V23

Pin 1 -	-1100V 610K
2 -	-1250V 650K
3 -	-1250V 600K
4 -	6.3VAC 0.3
5 -	6.3VAC 0.3
6 -	-1100V 610K
7 -	-1250V 650K
8 -	-1250V 600K
9 -	6.3VAC 0.3

V24

Pin 1 -	—
2 -	5VAC 4MEGO 0 590V
3 -	—
4 -	710VAC 0 (to T6, Term. 3)
5 -	—
6 -	710VAC 0 (to T6, Term. 3)
7 -	—
8 -	5VAC 0

V25

Pin 1 -	—
2 -	710VAC 0.6 (to T6, Term. 3)
3 -	—
4 -	-1250V 600K
5 -	—
6 -	-1250V 600K
7 -	—
8 -	710VAC 0.6 (to T6, Term. 3)

Figure 7-2. Main-Chassis Voltage and Resistance Chart (Sheet 1 of 2)

NOTES

All voltage measurements are dc to ground, unless otherwise indicated.

Voltmeter is 20,000 ohms-per-volt instrument.

All resistance measurements are to ground, unless otherwise indicated.

Control settings:

SYNC SELECTOR:	INT
MODULATION SELECTOR:	INT
PULSE RATE:	100
RATE MULTIPLIER:	X10
PULSE DELAY:	2.5
PULSE WIDTH:	10

V26

Pin 1 -	6.5VAC
	0.1
2 -	590V
	5MEGO
3 -	-67V
	5MEGO
4 -	0V
	7.0
5 -	6.5VAC
	0.1
Cap -	590V

V27

Pin 1 -	-67V
	5MEGO
2 -	213V
	450K
3 -	209V
	Infinite
4 -	6.3VAC
	5
5 -	6.3VAC
	5
6 -	213V
	450K
7 -	-330V
	310K
8 -	-327V
	850K
9 -	6.3VAC
	5

V28

Pin 1 -	—
2 -	-87V
	110K
3 -	—
4 -	—
5 -	0V
	7.0
6 -	—
7 -	-87V
	110K

V29

Pin 1 -	—
2 -	-172V
	Infinite
3 -	—
4 -	—
5 -	-87V
	110K
6 -	—
7 -	—

V30

Pin 1 -	—
2 -	-260V
	Infinite
3 -	—
4 -	—
5 -	-172V
	Infinite
6 -	—
7 -	—

V31

Pin 1 -	—
2 -	-345V
	800K
3 -	—
4 -	—
5 -	-260V
	Infinite
6 -	—
7 -	—

V34

Pin 1 -	—
2 -	5.1VAC
	0.11
-	430V
	2MEGO
3 -	—
4 -	1060VAC
	46
5 -	—
6 -	1060VAC
	46
7 -	—
8 -	5.1VAC
	0.11

V35

Pin 1 -	-3.2V
	200K
2 -	0V
	0.1
3 -	6.3VAC
	0.1
4 -	6.3VAC
	0.1
5 -	190V
	2.5MEGO
6 -	105V
	122K
7 -	0V
	0

V36

Pin 1 -	105V
	120K
2 -	0V
	0
3 -	—
4 -	—
5 -	105V
	120K
6 -	—
7 -	—

V37

Pin 1 -	185V
	2.5MEGO
2 -	418V
	2MEGO
3 -	262V
	130K
4 -	185V
	2.5MEGO
5 -	418V
	2MEGO
6 -	262V
	130K
7 -	6.3VAC
	0.1
8 -	6.3VAC
	0.1

V38

Pin 1 -	0V
	50
2 -	3.6V
	150
3 -	6.3VAC
	0.7
4 -	6.3VAC
	0.7
5 -	250V
	130K
6 -	180V
	140K
7 -	0.9V
	150

V39

Pin 1 -	0V
	450K
2 -	19V
	700
3 -	6.3VAC
	0.7
4 -	6.3VAC
	0.7
5 -	245V
	127K
6 -	180V
	140K
7 -	19V
	700

Figure 7-2. Main-Chassis Voltage and Resistance Chart (Sheet 2 of 2)

NOTES

All voltage measurements are dc to ground, unless otherwise indicated.

Voltmeter is 20,000 ohms-per-volt instrument.

All resistance measurements are to ground, unless otherwise indicated.

Control settings:

SYNC SELECTOR:	INT
MODULATION SELECTOR:	INT
PULSE RATE:	100
RATE MULTIPLIER:	X10
PULSE DELAY:	2.5
PULSE WIDTH:	10

V14

Pin 1 -	810VAC 7.5K
2 -	—
3 -	6.3VAC 0.8
4 -	6.3VAC
5 -	—
6 -	-870VAC 3MEGO
7 -	-870V

V15

Pin 1 -	-870V 3MEGO
2 -	-1100V 3MEGO
3 -	-1100V 630K
4 -	6.3VAC 0.2
5 -	6.3VAC 0.2
6 -	-870V 3MEGO
7 -	-1100V 4MEGO
8 -	-1100V 630K
9 -	6.3VAC 0.2

V16

Pin 1 -	-870V 3MEGO
2 -	-1100V 3MEGO
3 -	-1100V 630K
4 -	6.3VAC 0.2
5 -	6.3VAC 0.2
6 -	-870V 3MEGO
7 -	-1100V 4MEGO
8 -	-1100V 630K
9 -	6.3VAC 0.2

V17

Pin 1 -	-1250V 700K
2 -	-1250V 650K
3 -	6.3VAC 0.2
4 -	6.3VAC 0.2
5 -	-1100V 2.5MEGO
6 -	-1100V 620K
7 -	-1250V 650K

V18

Pin 1 -	-1250V 650K
2 -	—
3 -	—
4 -	—
5 -	-1250V 650K
6 -	—
7 -	-1358V 600K

V19

Pin 1 -	—
2 -	5VAC 0.1 -1800V
3 -	—
4 -	980VAC 1K
5 -	—
6 -	980VAC 1K
7 -	—
8 -	5VAC 0.1

V20

Pin 1 -	-1100V 2MEGO
2 -	-1250V 3MEGO
3 -	-1250V 600K
4 -	6.1VAC 0.2
5 -	6.1VAC 0.2
6 -	-1100V 2MEGO
7 -	-1250V 3MEGO
8 -	-1250V 600K
9 -	6.1VAC 0.2

V21

Pin 1 -	-1600V 950K
2 -	-1600V 770K
3 -	6.5VAC 0.4
4 -	6.5VAC 0.4
5 -	-1250V 3MEGO
6 -	-1450V 700K
7 -	-1600V 780K

V22

Pin 1 -	-1600V 750K
2 -	-1700V 850K
3 -	—
4 -	—
5 -	-1600V 750K
6 -	—
7 -	—

V23

Pin 1 -	-1100V 610K
2 -	-1250V 650K
3 -	-1250V 600K
4 -	6.3VAC 0.3
5 -	6.3VAC 0.3
6 -	-1100V 610K
7 -	-1250V 650K
8 -	-1250V 600K
9 -	6.3VAC 0.3

V24

Pin 1 -	—
2 -	5VAC 4MEGO 0 590V
3 -	—
4 -	710VAC 0 (to T6, Term. 3)
5 -	—
6 -	710VAC 0 (to T6, Term. 3)
7 -	—
8 -	5VAC 0

V25

Pin 1 -	—
2 -	710VAC 0.6 (to T6, Term. 3)
3 -	—
4 -	-1250V 600K
5 -	—
6 -	-1250V 600K
7 -	—
8 -	710VAC 0.6 (to T6, Term. 3)

Figure 7-2. Main-Chassis Voltage and Resistance Chart (Sheet 1 of 2)

NOTES

All voltage measurements are dc to ground, unless otherwise indicated.

Voltmeter is 20,000 ohms-per-volt instrument.

All resistance measurements are to ground, unless otherwise indicated.

Control settings:

SYNC SELECTOR:	INT
MODULATION SELECTOR:	INT
PULSE RATE:	100
RATE MULTIPLIER:	X10
PULSE DELAY:	2.5
PULSE WIDTH:	10

V26

Pin 1	-	6.5VAC
		0.1
2	-	590V
		5MEGO
3	-	-67V
		5MEGO
4	-	0V
		7.0
5	-	6.5VAC
		0.1
Cap	-	590V

V27

Pin 1	-	-67V
		5MEGO
2	-	213V
		450K
3	-	209V
		Infinite
4	-	6.3VAC
		5
5	-	6.3VAC
		5
6	-	213V
		450K
7	-	-330V
		310K
8	-	-327V
		850K
9	-	6.3VAC
		5

V28

Pin 1	-	—
2	-	-87V
		110K
3	-	—
4	-	—
5	-	0V
		7.0
6	-	—
7	-	-87V
		110K

V29

Pin 1	-	—
2	-	-172V
		Infinite
3	-	—
4	-	—
5	-	-87V
		110K
6	-	—
7	-	—

V30

Pin 1	-	—
2	-	-260V
		Infinite
3	-	—
4	-	—
5	-	-172V
		Infinite
6	-	—
7	-	—

V31

Pin 1	-	—
2	-	-345V
		800K
3	-	—
4	-	—
5	-	-260V
		Infinite
6	-	—
7	-	—

V34

Pin 1	-	—
2	-	5.1VAC
		0.11
	-	430V
		2MEGO
3	-	—
4	-	1060VAC
		46
5	-	—
6	-	1060VAC
		46
7	-	—
8	-	5.1VAC
		0.11

V34

V35

Pin 1	-	-3.2V
		200K
2	-	0V
		0.1
3	-	6.3VAC
		0.1
4	-	6.3VAC
		0.1
5	-	190V
		2.5MEGO
6	-	105V
		122K
7	-	0V
		0

V36

Pin 1	-	105V
		120K
2	-	0V
		0
3	-	—
4	-	—
5	-	105V
		120K
6	-	—
7	-	—

V37

Pin 1	-	185V
		2.5MEGO
2	-	418V
		2MEGO
3	-	262V
		130K
4	-	185V
		2.5MEGO
5	-	418V
		2MEGO
6	-	262V
		130K
7	-	6.3VAC
		0.1
8	-	6.3VAC
		0.1

V38

Pin 1	-	0V
		50
2	-	3.6V
		150
3	-	6.3VAC
		0.7
4	-	6.3VAC
		0.7
5	-	250V
		130K
6	-	180V
		140K
7	-	0.9V
		150

V39

Pin 1	-	0V
		450K
2	-	19V
		700
3	-	6.3VAC
		0.7
4	-	6.3VAC
		0.7
5	-	245V
		127K
6	-	180V
		140K
7	-	19V
		700

Figure 7-2. Main-Chassis Voltage and Resistance Chart (Sheet 2 of 2)

NOTES

All voltage measurements are dc to ground, unless otherwise indicated.

Voltmeter is 20,000 ohms-per-volt instrument.

All resistance measurements are to ground, unless otherwise indicated.

Control settings:

SYNC SELECTOR:	INT
MODULATION SELECTOR:	INT
PULSE RATE:	100
RATE MULTIPLIER:	X10
PULSE DELAY:	2.5
PULSE WIDTH:	10

V1		V2		V3		V4		V5		V6		V7		V8		V9	
Pin 1 -	234V 120K	Pin 1 -	248V 140K	Pin 1 -	182V 130K	Pin 1 -	248V 125K	Pin 1 -	207V 172K	Pin 1 -	111V 162K	Pin 1 -	247V 125K	Pin 1 -	2.1V 830K	Pin 1 -	-26V 82K
2 -	36V 45K	2 -	-6.7V 100K	2 -	66V 1.05MEGO	2 -	-6.8V 90K	2 -	0V 0	2 -	0V 0	2 -	-0.5V 90K	2 -	0V 0	2 -	0V 0
3 -	60V 11K	3 -	0V 0	3 -	66V 1.3K	3 -	0V 0	3 -	3.9V 4.7K	3 -	1.6V 220	3 -	0V 0	3 -	6.3VAC 0.1	3 -	6.3VAC 0.1
4 -	6.3VAC 0.1	4 -	6.3VAC 0.1	4 -	6.3VAC 0.1	4 -	6.3VAC 0.1	4 -	6.3VAC 0.1	4 -	6.3VAC 0.1	4 -	6.3VAC 0.1	4 -	6.3VAC 0.1	4 -	6.3VAC 0.1
5 -	6.3VAC 0.1	5 -	6.3VAC 0.1	5 -	6.3VAC 0.1	5 -	6.3VAC 0.1	5 -	6.3VAC 0.1	5 -	6.3VAC 0.1	5 -	6.3VAC 0.1	5 -	212V 127K	5 -	242V 130K
6 -	280V 135K	6 -	185V	6 -	248V 140K	6 -	248V 125K	6 -	159V 410K	6 -	242V 140K	6 -	247V 125K	6 -	105V 140K	6 -	193V Infinite
7 -	0V 1.05MEGO	7 -	58V	7 -	0V 46K	7 -	-8.8V 90K	7 -	-26V 71K	7 -	-22V 198K	7 -	-11V 90K	7 -	0V 0	7 -	0V 0
8 -	1.85V 250	8 -	60V	8 -	66V 1.3K	8 -	0.06V 350	8 -	0V 0	8 -	1.6V 220	8 -	0.05V 370				
9 -	6.3VAC 0.1	9 -	6.3VAC 0.1	9 -	6.3VAC 0.1	9 -	6.3VAC 0.1	9 -	6.3VAC 0.1	9 -	6.3VAC 0.1	9 -	6.3VAC 0.1				

Figure 7-3. Modulator-Chassis Voltage and Resistance Chart

NOTES

All voltage measurements are dc to ground, unless otherwise indicated.

Voltmeter is 20,000 ohms-per-volt instrument.

All resistance measurements are to ground, unless otherwise indicated.

Control settings:

SYNC SELECTOR:	INT
MODULATION SELECTOR:	INT
PULSE RATE:	100
RATE MULTIPLIER:	X10
PULSE DELAY:	2.5
PULSE WIDTH:	10

V10	V11	V12
Pin 1 - -1300V 1.6MEGO	Pin 1 - -1100V 600K	Pin 1 - -1650V 1MEGO
2 - -1300V 600K	2 - -1200V 600K	2 - —
3 - 6.3VAC 0.2	3 - -1200V 620K	3 - 6.3VAC 0.2
4 - 6.3VAC 0.2	4 - 6.3VAC 0.2	4 - 6.3VAC 0.2
5 - -1200V 600K	5 - —	5 - —
6 - -1200V 600K	6 - —	6 - -1650V 1MEGO
7 - -1300V 600K	7 - —	7 - -1250V 600K
	8 - —	
	9 - 6.3VAC 0.2	

Figure 7-4. Keyer-Chassis Voltage and Resistance Chart

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